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The First Italian Dreadnought Dante Alighieri

BY DAGNINO ATTILIO

The *Dante Alighieri* was built in the Royal Navy Yard at Castellamare di Stabia. She is one of six big-gun battleships recently authorized by the Italian Parliament. Her machinery was furnished by Messrs. Gio. Ansaldo & Company, from the Sampierdarena and Cornegliano Works. The vessel was designed for a speed of 22.50 knots on a displacement of 18,200 tons, with the main turbines developing 26,000 shaft horsepower, a performance which was easily attained, as shown by the trial data given later.

Notwithstanding the very powerful armament provided, the armored protection is most effective, particularly against torpedo attack. The main broadside armor is of special quality steel 10 inches in thickness, extending considerably below the water line. There is an armored deck at the water line level, and in addition to this there is an armored deck closing in the ship from stem to stern at the level of the top of the side armor. There is also a special arrangement of armored bulkheads protecting the vital parts of the ship; the magazines, for instance, being completely surrounded with special steel armor.

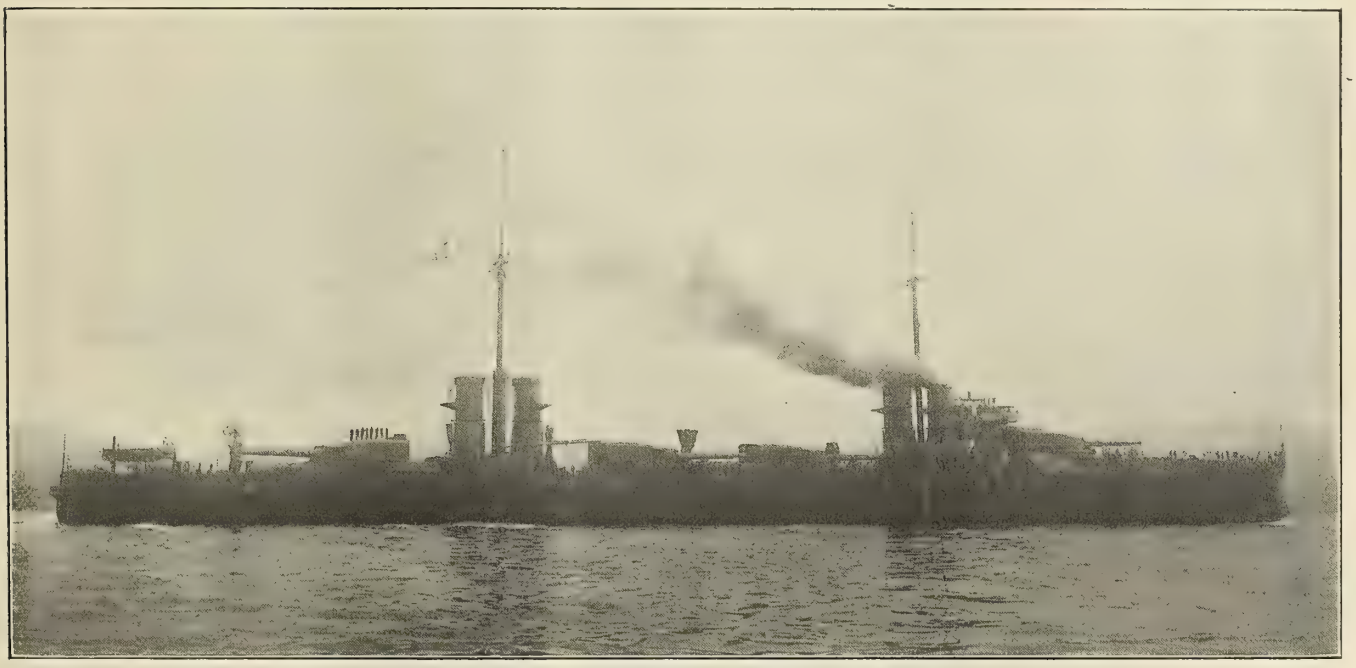


FIG. 1.—ITALY'S FIRST DREADNOUGHT, THE DANTE ALIGHIERI

Principal Data

Like all recent battleships, the *Dante Alighieri* is of familiar all-big-gun type, with principal dimensions as given in Table 1.

TABLE 1.—PRINCIPAL HULL DATA

Length between, perpendiculars, feet and inches	519 $2^{11}/_{16}$
Length over all, feet and inches	551 $2^{7}/_{16}$
Breadth, extreme at L. W. L. outside of armor, feet and inches	87 $1^{1}/_{16}$
Draft to L. W. L., feet and inches	27 $^{15}/_{16}$
Corresponding displacement, tons	18,400
Ratio of length to beam	5.95

Battery

The main battery consists of twelve 12-inch rifles arranged in four armored turrets on the center line of the vessel. A secondary battery is also provided with twenty 4¾-inch rapid fire guns, eight of which are located in four armored turrets, the other twelve being situated at the sides of the vessel on the battery deck. Further there are thirteen 3-inch rapid fire guns with other smaller guns, together with three submarine torpedo tubes, one located aft just at the water line and two forward at the sides of the vessel.

Steering Gear

The steering gear consists of a right and left-handed screw, connected through nuts and links to the crosshead on the rudder stock. This gear is connected through two lines of shafting and gears respectively to the steering engine and to an electrical motor located in separate compartments. The steering engine is of the vertical double type, with cylinders 16 inches diameter by 12 inches stroke, built by Gio. Ansaldo & Company. This company also furnished the electrical apparatus and all other parts of the steering gear. Four large wheels for hand steering are located in the hand-steering room. Suitable clutches are provided for disconnecting the gear when not in use, which is also the case with the steering engine. The rudder is of the usual balanced type.

Main Engines

The propelling machinery consists of Parsons turbines ar-

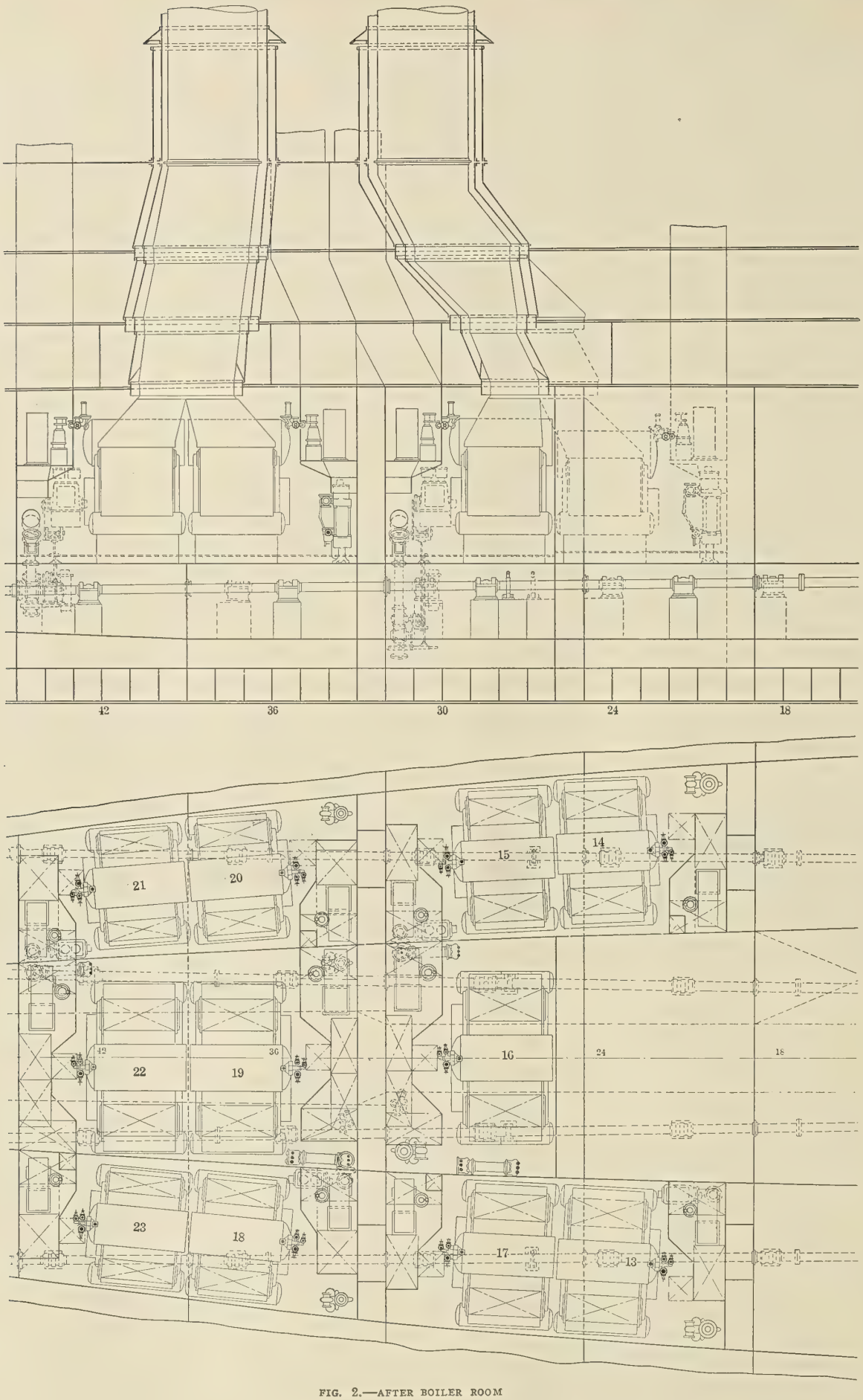


FIG. 2.—AFTER BOILER ROOM

ranged on four lines of shafting (see Fig. 3). The arrangement provides for six ahead and four astern turbines disposed in three watertight compartments. For ahead motion the outboard shafts are driven each by a high-pressure turbine coupled with a low-pressure turbine working in series when the ship runs at full speed, and exhausting into separate condensers. These turbines are designed for 410 revolutions at full power. The inboard port shaft is driven by a main high-pressure turbine (ahead) coupled with a separate astern turbine. The inboard starboard shaft is driven by a low-pressure ahead turbine which has an astern turbine incorporated. These turbines are designed for 330 revolutions at full power.

All six turbines are used for full speed ahead, constituting three separate groups, steam being admitted in each of three high-pressure turbines and expanded through their respective low-pressure turbines into separate condensers. When cruising at slow speed only four turbines are used, steam being admitted to the starboard outboard high-pressure turbine and expanded successively through the port outboard high-pressure turbine, main port inboard high-pressure turbine and the

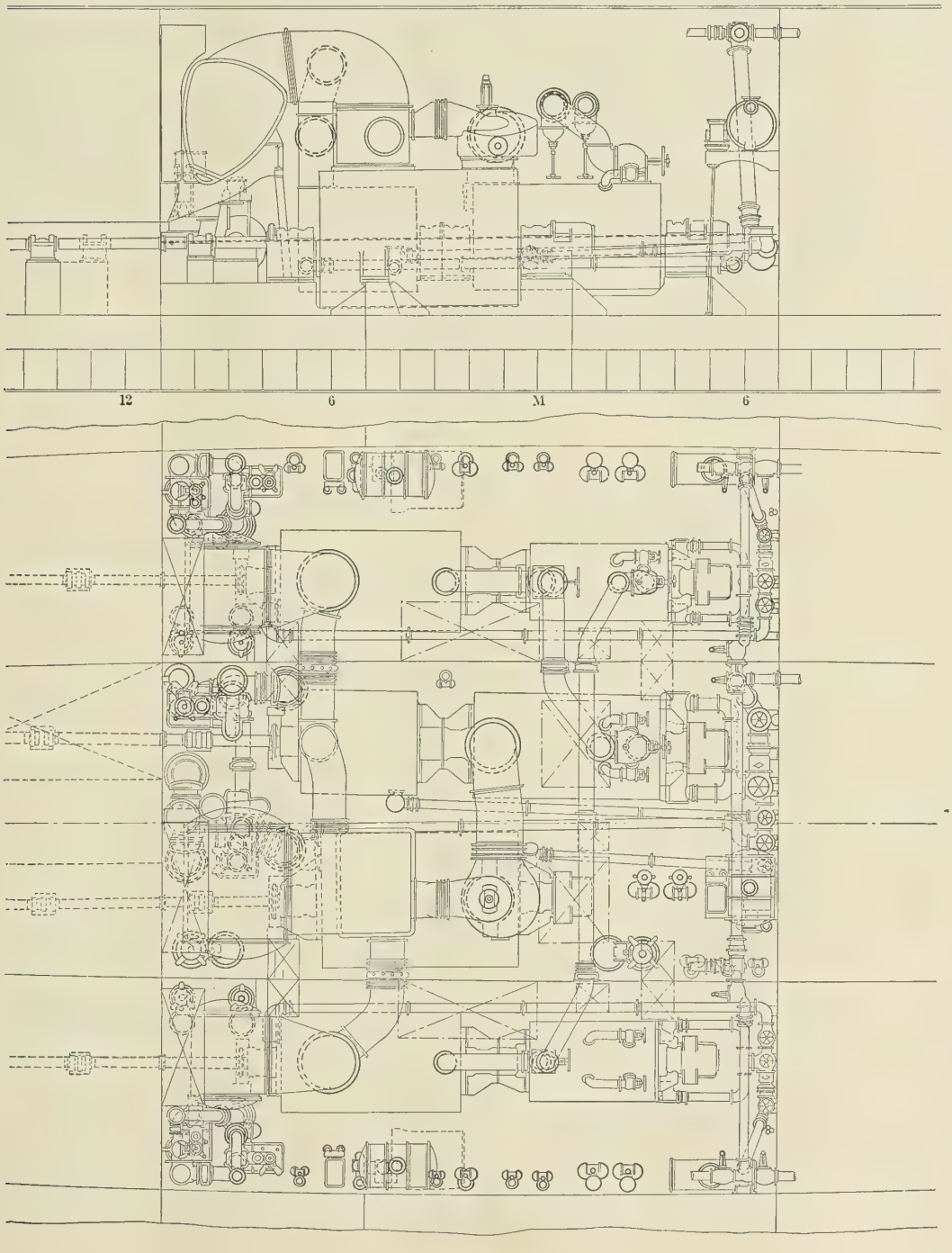


FIG. 3.—ENGINE ROOM

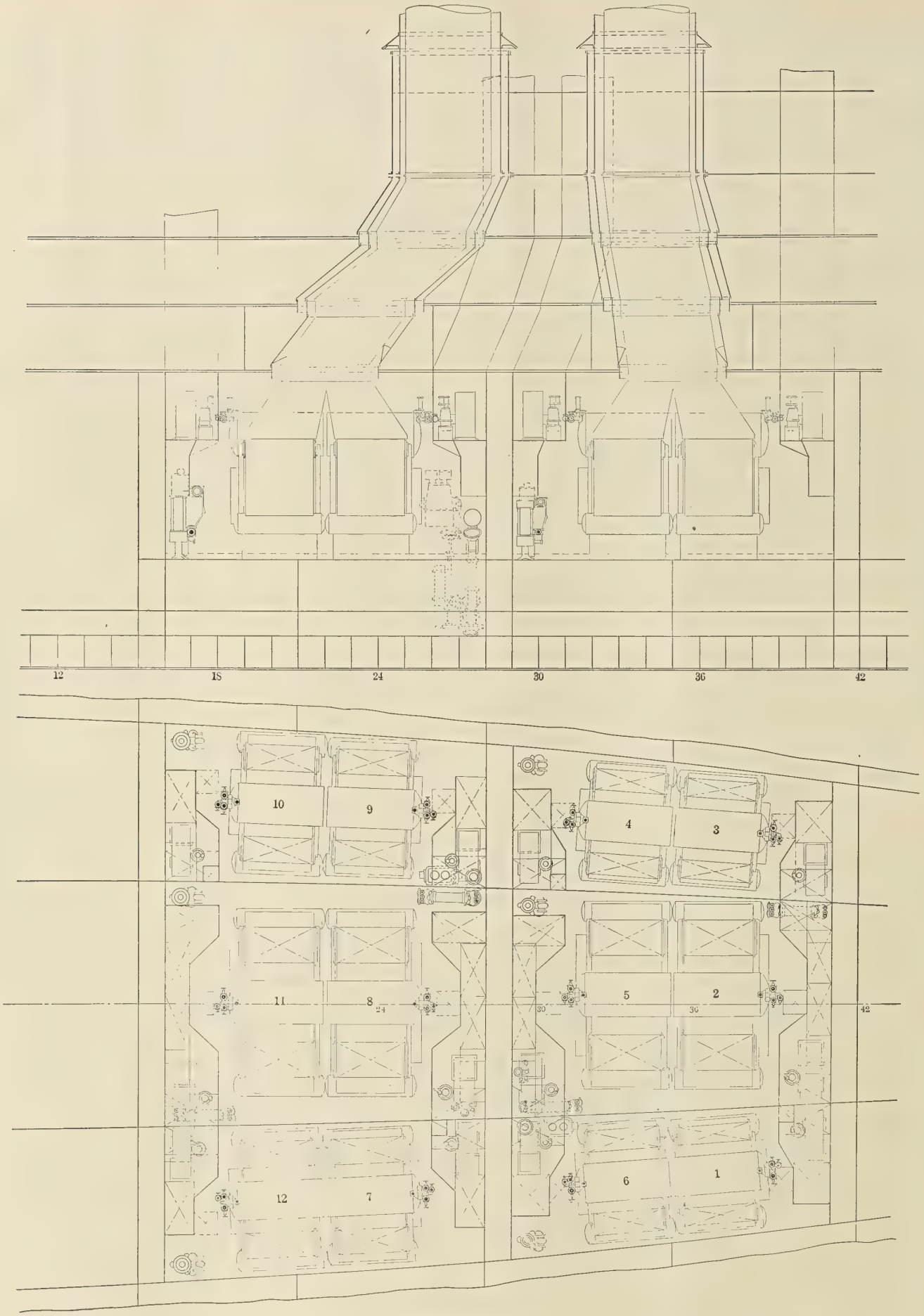
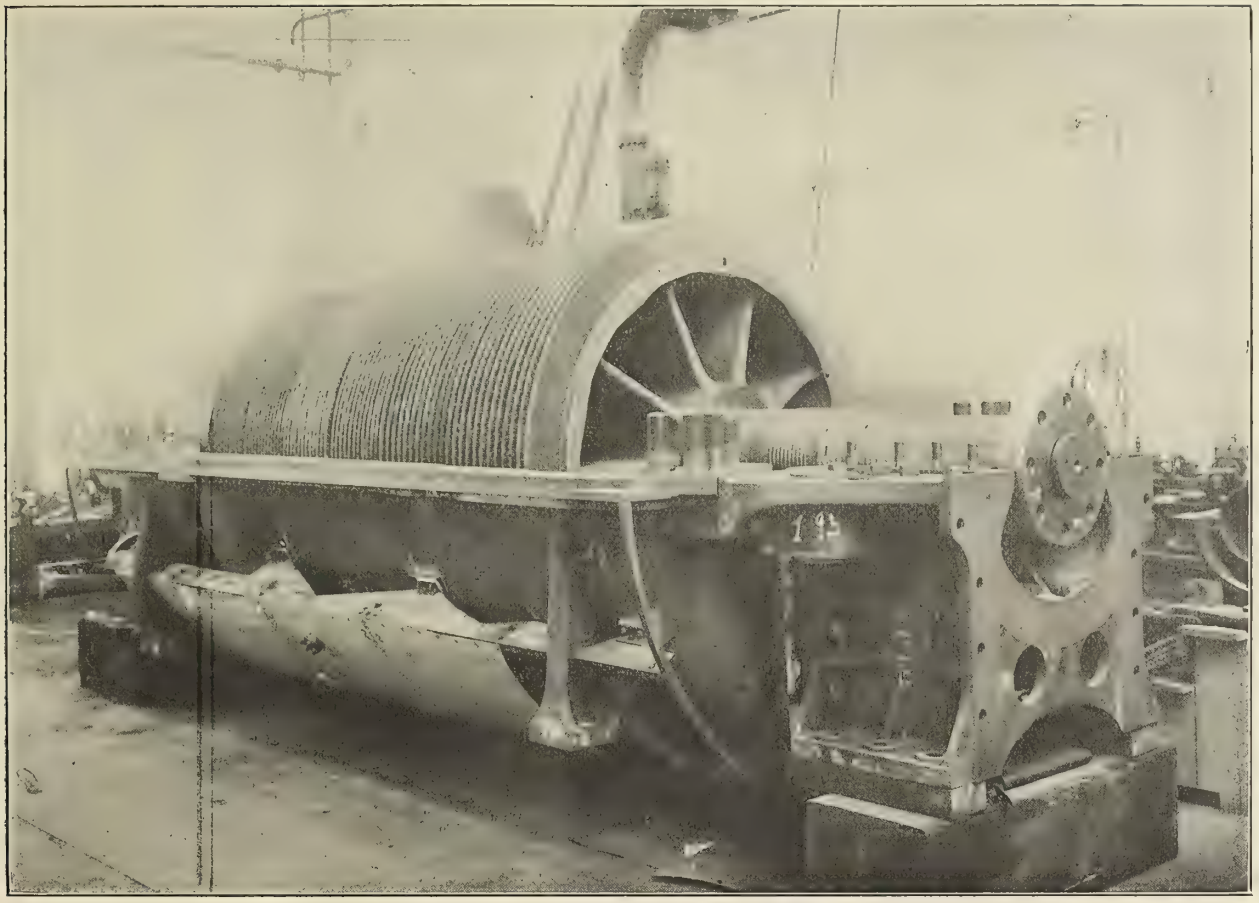
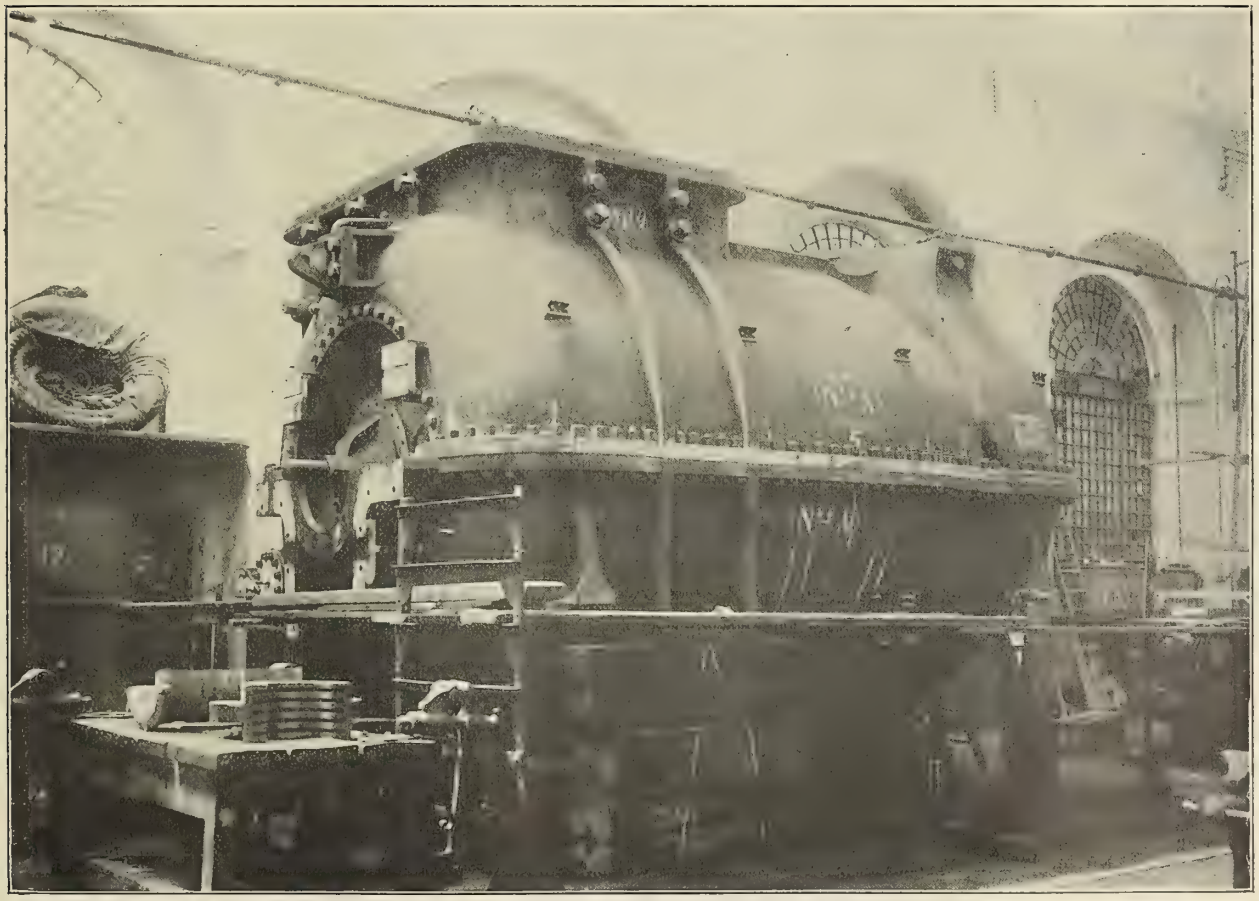


FIG. 4.—FORWARD BOILER ROOM





FIGS. 5 AND 6.—HIGH AND LOW-PRESSURE TURBINES

TABLE 2.—MAIN TURBINE DATA.

MOTOR DRUM.

	Diameter.	Length.
Main central port H. P., inches	68 1/2	116 1/16
Wing starboard H. P., inches	52	89 7/8
Wing port H. P., inches	54	71 5/16
Two wing, L. P., inches	78 3/4	70 7/16
Two wing astern, inches	56	54 9/16
Two central astern, inches	69 5/8	61
Central starboard L. P., inches	95	75 7/8

NUMBER OF EXPANSIONS.

Main central port H. P	6
Wing starboard H. P	4
Wing port H. P	4
Two wing L. P	6
Two wing astern	4
Two central astern	4
Central starboard L. P	6

TURBINE CASINGS, DIAMETER, INCHES, EACH EXPANSION.

Main central port H. P	70 5/8	71 11/16	73 5/32	75 3/16	78 3/16	82 5/16
Wing port H. P	55	55 3/16	55 9/16	56 11/32		
Wing starboard H. P	54 1/32	54 3/4	55 1/2	56 3/16		
Two wing L. P	81 3/32	83 5/16	85 13/16	85 13/16	85 13/16	85 13/16
Two wing astern	71	72 3/4	70 11/16	70 11/16		
Central starboard L. P	106	101	117	123	123	123

LENGTH OF CASING FOR EACH EXPANSION AND DIAMETER NOTED ABOVE.

Main central port H. P., inches	13 7/16	14 15/16	15 5/32	15 5/8		
Wing port H. P., inches	11 7/16	16 3/4	16 3/4	21 7/16		
Wing starboard H. P., inches	18 5/16	19 1/2	20 5/8	21 7/8		
Two wing L. P., inches	10 3/16	10 3/16	12 1/2	12 3/16	12 3/16	12 3/16
Two wing astern, inches	9 3/4	12	12	13		
Two central astern, inches	15	13 3/4	13 3/4	11		
Central starboard L. P., inches	8 1/32	9 7/16	11 3/16	9 3/16	10 3/16	11

ROWS OF BLADING FOR EACH EXPANSION.

Main central port H. P	12
Wing starboard H. P	16
Wing port H. P	18
Two wing L. P	3 of 7; 3 of 6
Two wing astern	9
Two central astern	11
Central starboard L. P	3 of 6; 3 of 5

LENGTH OF BLADES FOR EACH EXPANSION, INCHES.

Main central port H. P	14	14	14	11	8	8 1/2
Wing starboard H. P	2 1/8	1 3/4	1 3/8	1 1/16		
Wing port	1 1/16	1 3/16	5/8	1/2		
Two wing	8 1/2	8 1/2	8 1/2	3 9/16	2 5/16	1 5/8
Two wing astern	5/8	1 3/16	2 3/8	2 3/8		
Two central astern	2 9/16	2 9/16	1 1/4	3/8		
Central starboard	14	14	14	11	8	8 1/2

ROTOR SHAFT AND BEARING.

	Length, Inches.	Diameter, Inches.	Length Overall, Rotor, Drum and Shaft, Inches.
Main H. P	17 7/8	13 3/4	278 11/32
Two L. P. wing ahead	24 3/8	11 11/16	259 15/16
H. P. starboard wing	11 21/32	11 11/16	218 1/2
H. P. port wing	11 21/32	11 11/16	236
H. P. astern, independent	13 7/8	13 3/4	172
L. P. central and astern	31	13 3/4	313 3/4

THRUST BEARINGS.

	Central or Main H. P.	L. P. Ahead.	H. P. Starboard.	H. P. Port.
Collar on shaft, number	11	19	18	18
Thickness, inches	13/16	13/16	11/16	11/16
Distance between, inches	16 9/16	16 9/16	15	15
Outside diameter, inches	11 3/32	11 3/32	16 7/16	16 7/16
Number of shoes, top	18	18	17	17
Number of shoes, bottom	19	19	18	19

TABLE 3.—SHAFT DATA.

		Wing Shafts.	Central Shafts.
Line shafts, diameter outside, inches		10 7/16	11 9/16
Axial hole, inches		5 5/16	6 11/16
Stern tube shafts, diameter outside, inches		11 1/32	12 5/32
Axial hole, inches		5 5/16	6 11/16
Couplings, diameter, inches		17 1/2	19 13/16
Thickness, inches		2 7/16	2 3/4
Propeller shafts, diameter outside, inches		11 21/32	12 5/32
Axial hole, inches		5 5/16	6 11/16
Diameter of sleeve outside, inches		12 9/16	13 3/8
Inside, inches		11 1/8	12 5/16
Length of sleeve, inches	Fore.	72 7/16	71 21/32
	Aft.	95 1/4	95 1/4
Coupling bolts, number each coupling		8	8
Diameter (taper) at face of coupling, inches		1 31/32	2 3/8
Forward stern tube bearings, diameter, inches		15 5/8	16 7/8
Length, inches		54 1/8	54 1/8
After stern tube bearings, diameter, inches		15 5/8	16 7/8
Length, inches		83 1/4	83 1/4

TABLE 4.—PROPELLER DATA.

	Central Propeller.	Wing Propeller.
Diameter of propeller, inches	114 3/4	94
Hub, inches	23 5/8	22
Pitch, inches	108	88
Ratio of diameter to pitch	1.05	1.05
Area projected, square inches	6117.07	4161.75
Helicoidal, square inches	6833.17	6144.20
Disk, square inches	10183.50	6928.50
Ratio projected to disk area	0.6	0.5985
Helicoidal to disk area	6.009	4.49

TABLE 5.—THE UNIFLUX CONDENSERS ARE OF THE FOLLOWING PRINCIPAL DIMENSIONS.

	No. 1 Central Condenser.	No. 2 Lateral Condenser.
Thickness of shell, inches	1/2	5/16
Length between tube sheets, inches	86 1/4	85 1/16
Thickness of tube sheets, inches	1	1
Number of tubes	7938	3344
Diameter of tubes, inches	5/8	5/8
Thickness of tubes, B. W. G.	18	18
Exhaust nozzle, inches	70 1/32 x 81 3/32	33 7/8 x 76 9/16
Air pump suction, inches	14	9
Circulating water inlet and outlet, inches	34	10 7/16
Cooling surface, square feet	12734	3997

TABLE 6.—BOILER DATA.

Number	23
Working pressure, pounds per square inch	235.2
Test pressure, pounds per square inch	308.7
Drum diameter, inches	50
Length, inches	113 7/16
Thickness, inches	9/16
Total grate surface, square feet	1858.08
Ratio G. S. to H. S.	56.01
Total smoke pipe area, square feet	342.51
Kind of forced draft	Closed boiler rooms.
G. S. ÷ area through smoke pipe	5.42

starboard inboard low-pressure ahead turbine, exhausting into the central condenser; the remaining turbines revolving idly in a vacuum.

For astern motion each of the four astern turbines may be used independently of each other.

Self-closing valves are fitted in the receiver pipes between the starboard outboard high-pressure turbine and the port outboard high-pressure turbine, and between that one and main inboard high-pressure turbine (as shown in the drawing) to prevent back flow of steam when changing from the cruising combination to full speed conditions. The turbines

TABLE 7.—R. I. N. DANTE ALIGHIERI. TRIAL DATA.

Duration of Trials in Hours.	Number of Boilers Used.		Air Pressure in Fire Rooms.	Average Steam at Boilers.	Displacement Corresponding.	Draft Mean Before the Trial.				Draft Mean After the Trial.			
						Aft.		For'd.		Aft.		For'd.	
	Coal Boilers.	Oil Boilers.	Inches of Water	Pounds.	Tons.	Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	Feet.	Inches.
10	4	2	1½ to 1¾	189 to 226	18,230	28	10	28	5	26	1	28	4
18	23		1½ to 1¾	220.5	18,300	26	4	28	8	26	1	28	3
6	23		1½ to 1¾	225.5	18,200	26	3	28	6	26	..	28	3

Duration of Trials in Hours.	Slip of Propellers, Percent of Own Speed, Mean.		Speed in Knots.	Revolutions.				Power, I. H. P.	Coal Consumption. Pounds.
	Side.	Central.		Starboard Outboard Shaft.	Port Outboard Shaft.	Starboard Inboard Shaft.	Port Inboard Shaft.		
10	7.19	8.46	11.29	164	167	152	152	29,910	2.31
18	14.63	20.43	19.767–23.825	313	324	281	276	20,501	1.67
6	21.53	18.18	22.83 –23.825	398	400	317	317	32,189	1.56

are controlled from the working platform, where the regulating valves for admitting steam to the different turbines are located.

There is a main bearing at each end of each turbine for carrying the rotor. Each turbine, except the independent high-pressure (inboard astern) and the outboard low-pressure turbines coupled with its high-pressure turbine is provided with a thrust block at the forward end, consisting of a number of brass rings, in halves, fitting into corresponding collars on the shafts. The lower half of each ring is for taking the ahead and the upper half the astern thrust.

All main bearings, thrust bearings, and the line shaft bearings are provided with a closed system of forced lubrication. A Proell governor is fitted to each line of shafting, the governor mechanism operating the main steam stop valves in the engine room.

For main turbine data see Table 2.

SHAFTING

There are four lines of shafting, two on the port and starboard sides respectively. (For data see Table 3.)

PROPELLERS

There are four three-bladed propellers, all outboard turning when going ahead. The blades are true screw-machined to pitch. (For propeller data see Table 4.)

MAIN CONDENSING APPARATUS

There is one main condenser in each engine room. The starboard and port condensers are of the same dimensions, the central condenser is larger than the latter. (For condenser dimensions see Table 5.)

AUXILIARY MACHINERY

In each engine room there are air pumps, circulating pumps, auxiliary condenser, fire and bilge pumps, pumps for the forced lubrication system, etc.

BOILERS

There are twenty-three boilers of watertube type arranged in separate watertight compartments. They are designed to run the entire machinery installation at full power, with an average air pressure in the ash pits of not more than 1½ inches of water. (For boiler data see Table 6.)

TRIALS

Three trials were required of the *Dante Alighieri* as follows:

1. A full-speed trial of six hours' duration in the open sea at the highest speed obtainable, with an average air pressure in the ash pits not exceeding 1½ inches of water with not over 195 pounds steam pressure at the high-pressure turbines. The average power to be 26,000 shaft horsepower.

This trial took place at sea off Spezia on July 9. The designed speed was easily exceeded, an average speed being attained which set a new record in the navy for battleships.

2. An endurance and water and coal consumption trial in the open sea of eighteen hours' duration with an average power to be at least 16,500 shaft horsepower, to be followed with another six hours' duration trial for the purpose of obtaining complete data for all conditions of running which might be required in battle.

This trial took place successfully on July 16 and 17, with an average power of 20,501 shaft horsepower and a mean speed of 19.75 knots.

TABLE 8.—R. I. N. DANTE ALIGHIERI FULL POWER TRIAL DATA, JULY 9, 1912.

Time	Steam Pressure in the Turbines and Vacuum of Condensers.								
	H. P. Starboard	L. P. Starboard	Starboard Condenser	H. P. Port	L. P. Port	Port Condenser	H. P. Central	L. P. Central	Central Condenser
	Pounds	Pounds	Inches	Pounds	Pounds	Inches	Pounds	Pounds	Inches
12:5	182	21	25.2	119	23	26.1	125	0.7	27.9
12:35	189	24	26.4	119	23	26.1	139	2.1	27.9
13:5	186	19	26.7	104	20	28.4	139	3.5	27.9
13:35	182	18	26.1	102	18	28.4	136	3.1	27.9
14:5	186	19	26.1	111	21	28.4	145	4.2	27.9
14:35	183	20	25.8	111	21	28.4	145	4.2	27.9
15:5	182	21	25.8	111	21	26.1	143	4.5	27.9
15:35	179	20	25.8	110	20	28.4	142	4.2	27.9
16:5	179	20	26.1	110	21	28.4	140	4.2	27.9
16:35	186	20	25.8	112	21	28.4	140	4.4	27.9
17:5	182	20	26.1	111	21	28.4	143	4.9	27.9
17:35	182	20	25.8	111	20	28.4	145	4.8	27.9
18:5	170	17	26.1	111	21	28.4	139	4.1	27.9

Time	REVOLUTIONS.				S. H. P.				
	Side Starboard Turbine	Side Port Turbine	Central Starboard Turbine	Central Port Turbine	Side Starboard Turbine	Side Port Turbine	Central Starboard Turbine	Central Port Turbine	Total
12:5	385.5	395.5	300	297.5	6184.9	7808.4	7306.6	7333.5	28633.4
12:35	396	404	313	308	6832.4	7776.8	8474.8	8001.2	31085.2
13:5	392.5	396	316	312.5	6673.1	7467.8	8695.2	8402.8	31238.9
13:35	380	385	302.5	302.5	6658.1	7411.1	8598	8787.5	31455.1
14:5	391	404.5	315	314.5	6601.6	7834.7	8839.1	8669.4	31944.8
14:35	401.5	403.5	320	316	7298.3	7863.4	9219.8	8743.7	33125.2
15:5	402	402	319	317	7226.4	7820.4	9091.8	8837.4	32976
15:35	390	405	318	316.5	6539	8002.9	9063.3	8839.9	32445
16:5	399	408	319.5	317	7038.6	8048.3	8965.3	8721.8	32774
16:35	402.5	401	316.5	321.5	7079.8	7876.1	8995.9	8954.4	32906.2
17:5	398.5	397.5	317	313.5	6828.7	7800.5	8813	8699	32141.2
17:35	394.5	402.5	316.5	314.5	6773.4	8015.1	8856.6	8702.2	32347.3
18:5									

Total coal consumed in 6 hours = 76.5 tons.
Total oil fuel consumed in 6 hours = 39.5 tons.
Oil fuel reduced to coal = 53 tons.

Total as coal = 129.5 tons.

Mean coal consumption per hour = 47627 pounds.
Mean S. H. P. developed according:

$$\frac{\Sigma \frac{P}{N^3} N_c^3}{12} = 32189.9$$

Coal consumption per S. H. P. per hour $= \frac{47627}{32189} = 1.5$ lbs.

3. An endurance and water and coal consumption trial in the open sea of ten hours' duration running at low cruising speed.

This trial took place on July 24, the data of which are given in Table 7.

The results of all trials were most satisfactory and reflect great credit not only on the navy yard force, where the vessel was built, and the Gio. Ansaldo & Company's works, where the machinery was constructed, but particularly on the ship's engineering force from the navy and the builders, the organization, skill and energy of which displayed in handling the machinery throughout the trials were largely responsible for the success.

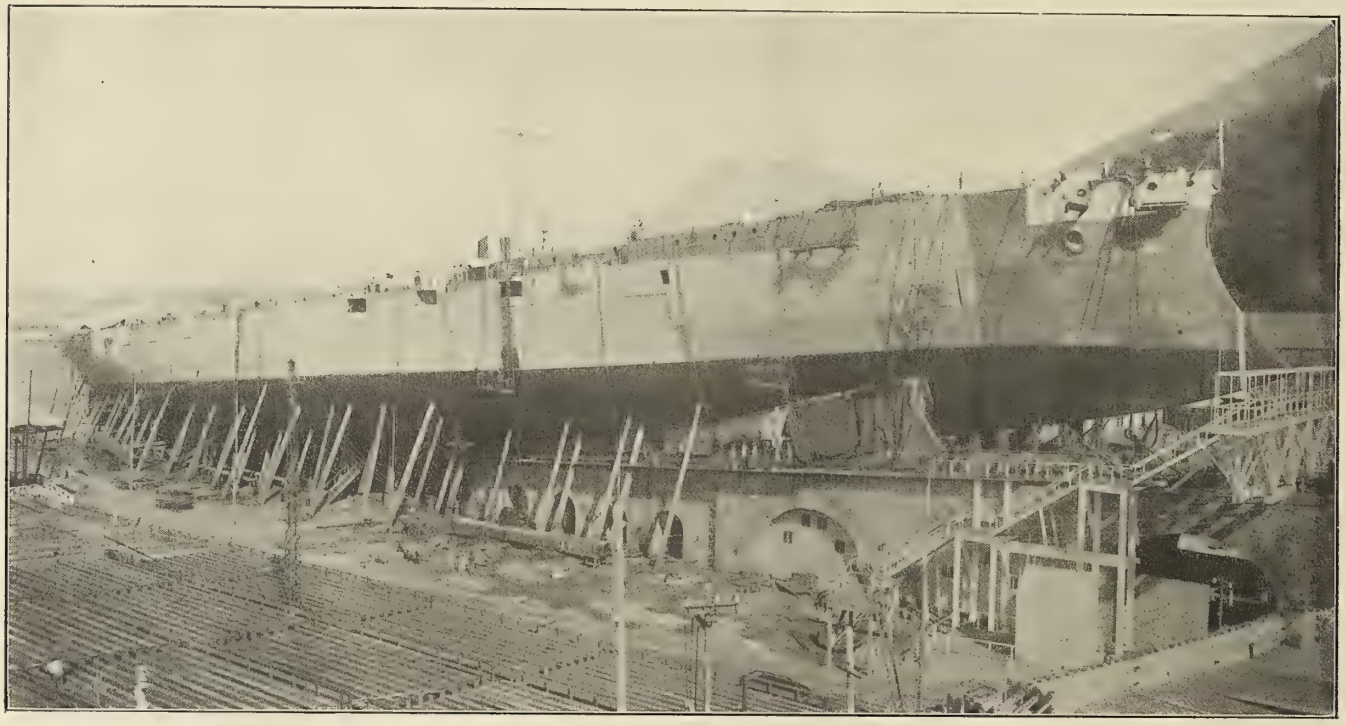


FIG. 7.—THE DANTE ALIGHIERI JUST BEFORE LAUNCHING

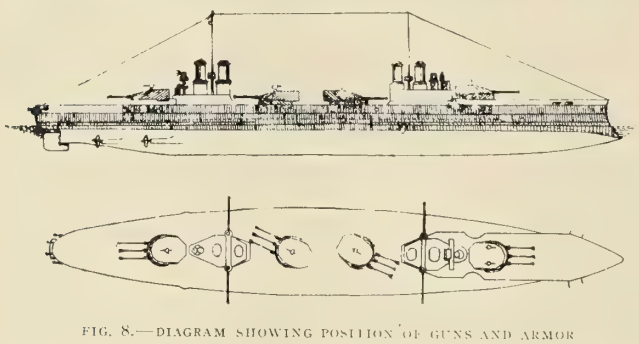


FIG. 8.—DIAGRAM SHOWING POSITION OF GUNS AND ARMOR

MONTHLY SHIPBUILDING RETURNS.—The Bureau of Navigation reports 140 sailing, steam and unrigged vessels of 33,006 gross tons built in the United States and officially numbered during the month of October, 1912. Five steel steamships aggregating 10,851 gross tons were built on the Atlantic coast, and four steel steamships with a total of 4,939 gross tons were built on the Great Lakes. The largest of these vessels were the *Middlesex,* of 4,727 gross tons, and the *El Segundo,* of 3,663 gross tons, both of which were built at the New York Shipbuilding yards, Camden, N. J.

Annual Report of Lloyd's Register of Shipping

According to the annual report of *Lloyd's Register of Shipping* at the close of the year ended June 30, 1912, there were 10,445 merchant vessels registering about 21,750,000 tons gross classed in the society's books. During the year classes were assigned by the committee to 684 new vessels of 1,468,166 gross tons. These figures represent 623 steamers of 1,455,988 tons and 61 sailing vessels of 21,178 tons. Of the total, about 68½ percent were built for the United Kingdom, and about 31½ percent for the British colonies and foreign countries. As compared with the figures for the preceding twelve months, the present reports following the general movement of the shipbuilding industry show an increase of 366,865 tons of steamships and 2,825 of sailing vessels.

A noticeable feature of the society's operations during the past year is the large number of steamers of upwards of 5,000 tons each which have received the 100 A-1 class. Eighty-six such vessels have been so classed this year.

The initial success of the Diesel engine for marine purposes is recognized. At the present time there is under construction under the supervision of *Lloyd's Register* Diesel engines for thirty-four vessels, twenty-three of these vessels having tonnages ranging from 2,000 to 10,000. It is evident that the construction of such vessels is rapidly increasing, more especially in Holland and Germany. It is felt, however, that the time has hardly yet arrived for the provision of rules on this subject.

An increasing amount of tonnage is being built for the society's classification on the Isherwood system. Up to the end of June, 64 of these vessels of 264,368 tons had received the society's classification. Since that date, 114 such vessels, registering 593,400 tons, have been completed, or are under course of construction, under the special survey of the society's surveyors.

The demand for new steamers intended for carrying oil in bulk has also enormously increased. Since July 1, 1911, 16 vessels of 66,911 tons, intended to be used for this purpose, have been assigned the society's classification, while there are

under construction, at home and abroad, no less than 87 vessels registering 479,000 tons for this purpose. In connection with the increase in the number of vessels under construction for carrying oil in bulk, there is also a great development taking place in the use of oil fuel instead of coal. From Jan. 1, 1910, to the present time there have been completed under the survey of the society's surveyors 15 oil-carrying vessels and 19 other vessels constructed with oil-fuel bunkers. At the present time oil-fuel bunkers are being constructed in 45 oil-carrying vessels and in 19 other vessels which are being built under the society's survey.

The period under review has witnessed a noticeable extension of the society's operations in the United States, where 40 vessels of 175,000 tons are now in course of construction for classification in Lloyd's registry book. Seventeen of these ships, aggregating 63,000 tons, are building on the Great Lakes.

Passage of Vessels through the Panama Canal

From the annual report of the Isthmian Canal Commission, just issued, it is apparent that the first vessel will pass through the canal some time during the summer or fall of 1913, although the official opening of the canal to the world's commerce will be considerably later, probably not before Jan. 1, 1915. Before the official opening of the canal for international traffic there is is a vast amount of detail work to be finished in connection with facilities for docking and repairing vessels, furnishing supplies of coal, oil, means for handling and transshipping freight and the provision of facilities for the operating staff.

When the canal is finished vessels will not be permitted to enter or pass through the locks under their own power, but will be towed through at the rate of 2 miles an hour by electric locomotives running on cog-rails laid on the tops of the lock walls. Electric power for towing the vessels and also for operating all gates and valves is to be generated by water turbines from the head created by Gatun Lake. When a ship is to pass through the canal it will come to a full stop in the forebay of the locks, where four hawsers will be attached to it, two forward on either side and two aft. At the other ends these hawsers will be attached to the windlasses of four towing locomotives operating on the lock walls, two forward for towing and two aft being towed by their hawsers, thus holding the ship steady. While the usual number of locomotives will be four, this will vary, of course, with the size of the vessel to be towed. The locomotives are equipped with a slip drum, towing windlass and hawser, which will permit the towing line to be taken in or paid out without actual motion of the locomotive on the track.

The locomotives will run on a level, excepting where they pass from one lock to another, where they will encounter heavy grades; between the lower and intermediate locks at Gatun, for example, there is a difference in elevation of 29 feet 7 inches, and in order to save concrete this ascent is made in the shortest feasible distance.

There will be two systems of tracks, one for towing and the other for the return of the locomotives when not towing. The only cross-over between the tracks will be at each end of the locks, and there will be no switches in the rack road.

The depth of water over the miter sills of the locks will be 40 feet in salt water and 41 1/3 feet in fresh water. The average time of filling and emptying a lock will be about 15 minutes, without opening the valves so suddenly as to create disturbing currents in the locks or approaches. The time required to pass a vessel through all the locks is estimated at three hours—one and one-half hours in the three locks on Gatun and about the same time in the three locks on the Pacific side. The time of passage of a vessel through the entire canal is estimated as ranging from 10 to 12 hours, according to the size of the ship and the rate of speed at which it can travel outside of the locks.

Progress of U. S. Naval Vessels

The Bureau of Construction and Repair, Navy Department, reports the following percentage of completion of vessels for the United States navy:

	Tons.	Knots.		Aug. 1.	Nov. 1.
BATTLESHIPS					
New York.	28,000	21	Navy Yard, New York.....	48.2	62.5
Texas	28,000	21	Newport News Shipb'g Co..	72.1	79.2
Nevada ...	28,000	20½	Fore River Shipb'g Co.....	4.0	10.1
Oklahoma .	28,000	20½	New York Shipb'g Co.....	3.3	9.3
TORPEDO BOAT DESTROYERS					
Henley ...	742	29½	Fore River Shipb'g Co.....	93.6	96.9
Cassin	742	29½	Bath Iron Works.....	42.3	60.4
Cummings .	742	29½	Bath Iron Works.....	30.7	52.7
Downes ...	742	29½	New York Shipb'g Co.....	16.4	25.0
Duncan ...	742	29½	Fore River Shipb'g Co.....	34.3	44.4
Aylwin ...	742	29½	Wm. Cramp & Sons.....	48.0	61.3
Parker	742	20½	Wm. Cramp & Sons.....	42.2	56.6
Benham ...	742	29½	Wm. Cramp & Sons.....	38.9	56.0
Balch	742	29½	Wm. Cramp & Sons.....	37.3	58.6
SUBMARINE TORPEDO BOATS					
F-4	....	....	Seattle Con. & D. D. Co....	90.8	94.6
G-4	....	....	Wm. Cramp & Sons.....	79.5	88.3
G-2	....	....	Newport News Shipb'g Co..	86.0	86.0
H-1	....	....	Union Iron Works.....	76.2	84.5
H-2	....	....	Union Iron Works.....	75.7	84.5
H-3	....	....	Seattle Con & D. D. Co.....	73.3	82.1
G-3	....	....	Lake T. B. Co.....	54.9	60.0
K-1	....	....	Fore River Shipb'g Co.....	43.9	54.2
K-2	....	....	Fore River Shipb'g Co.....	43.4	53.5
K-3	....	....	Union Iron Works.....	47.9	59.0
K-4	....	....	Seattle Con. & D. D. Co....	40.7	54.5
K-5	....	....	Fore River Shipb'g Co.....	26.2	38.6
K-6	....	....	Fore River Shipb'g Co.....	25.8	38.1
K-7	....	....	Union Iron Works.....	28.2	42.0
K-8	....	....	Union Iron Works.....	28.2	41.5
COLLIERS					
Proteus ...	20,000	14	Newport News Shipb'g Co...	61.9	72.0
Nereus ...	20,000	14	Newport News Shipb'g Co...	56.7	62.5
Jason	20,000	14	Maryland Steel Co.....	47.7	66.7
Jupiter	20,000	14	Navy Yard, Mare Island....	78.2	85.6

Panama Canal Tolls

In a proclamation issued Nov. 13, President Taft fixed the rates of tolls on vessels passing through the Panama Canal as follows:

1. On merchant vessels carrying passengers or cargo, $1.20 (5s.) per net vessel ton—each 100 cubic feet—of actual earning capacity.

2. On vessels in ballast without passengers or cargo, 40 percent less than the rate of tolls for vessels with passengers or cargo.

3. Upon naval vessels other than transports, colliers, hospital ships and supply ships, 50 cents (2s. 1d.) per displacement ton.

4. Upon army and navy transports, colliers, hospital ships and supply ships, $1.20 (5s.) per net ton, the vessels to be measured by the same rules as are employed in determining the net tonnage of merchant vessels.

Th Secretary of War will prepare and prescribe such rules for the measurement of vessels and such regulations as may be necessary and proper to carry this proclamation into full force and effect.

Institution of Naval Architects.—The annual meeting of the Institution of Naval Architects for 1913 will be held in London, March 12, 13 and 14. All papers or suggestions for discussion at this meeting should be sent to the secretary before the first of the year.

Engineering Progress in the United States Navy*

BY CAPTAIN C. W. DYSON, U. S. N.

In preparing an article under the heading of "Engineering Progress in the United States Navy," the ground to be covered is of such large extent that, in the greater part, nothing but the merest notice of improvements can be given, and only the most important points of progress will be detailed. The first and most important point of all as reacting upon the general efficiency of the navy as a reliable and economical fighting force, is the

Choice of Propelling Machinery for Heavy Vessels of Moderate Speed

In the selection of the type of machinery to be used in the above class of vessels, the following points must be taken into consideration:

(*a*) General character of the service which the vessel will be called upon to perform; whether she must keep the sea for long periods, cruising at speeds very much lower than her maximum speeds, or whether she will be called upon for very little slow cruising, but shall be held in readiness for dashes at high speed from a base to any threatened point.

(*b*) Greatest economy realized at the conditions under which she will be called upon to operate. This point is important, not only from the point of financial saving in reduced fuel cost, but in the greater case of fuel supply due to the decreased demands.

(*c*) Fuel capacity entailed by the demands of the service to which the vessel may be subjected.

(*d*) Ease of up-keep of the machinery, and degree to which the vessel, so far as machinery repairs are concerned, can be made self-supporting.

(*e*) Reliability of machinery when driven at high powers.

(*f*) Minimum weight and space required for the propelling machinery.

(*g*) Efficient propellers for maneuvering.

(*h*) Minimum of vibration of hull due to machinery in operation.

(*i*) Effect of vertical position of center of gravity of the machinery upon the time of roll of the vessel, in fixing the quality of the vessel as a gun platform.

The question of costs of the different types of machinery will not be considered in comparing the relative advantages of the types.

Further, the relative values of turbine reduction gear, electric propulsion and internal combustion engines for propulsion will not be dealt with, for the following reasons: The turbine reduction gear and electric propulsion are under trial in the naval service at the present time, the reduction gear being actually afloat while the vessel fitted with electric propulsion is building.

The results obtained up to date with the reduction gear have been disappointing so far as the expected economy is concerned, the results being vitiated by faulty turbines and too high a number of revolutions of propeller, 135 per minute, for the type of vessel and the speed, 14 knots. The reduction gears have, however, stood up to the work well and show practically no evidences of wear. Results are encouraging and a great improvement is expected when contemplated changes in the turbine have been made.

Electric propulsion not having been tried out in actual service, it is considered preferable to content ourselves with the mere statement that shop tests of one of the units have been very gratifying and promise a successful end to the experiment, so far as economy of propulsion only is considered.

As to the question of propulsion by internal combustion engines, where large powers are required, there appear still to be many important problems requiring solution before units of sufficiently high powers for the purpose desired can be built. The supplanting of the steam engine, both reciprocating and turbine, for important high-power installations does not appear to be imminent in the immediate future.

Eliminating these three latter methods of propelling naval vessels restricts the choice of machinery for this purpose to the three following methods:

1. By means of reciprocating engines.
2. By means of steam turbines, impulse, reaction, or a combination of the two.
3. By means of various combinations of reciprocating engines with turbines.

Comparative Suitability of Each of the Above Methods for Naval Purposes

To assist in reaching a decision as to which of the three methods of propulsion best meets the requirements lettered from (*a*) to (*i*), a comparison of the performances of the dreadnoughts *Delaware, North Dakota, Utah,* and *Florida* can be made; these performances include those on preliminary acceptance trials and those in actual service.

From the results obtained from these trials it appears justifiable to decide as follows:

Should the duties of a vessel be such that she be required to steam for long periods and long distances at speeds much lower than her designed maximum speed, a less fuel expenditure per day will be required, and consequently a greater cruising radius will be obtained and less frequent recoaling necessitated should reciprocating engines be fitted rather than turbines for propelling purposes.

Should, however, the vessel operate from a fixed base, only doing sufficient cruising to insure that the machinery is kept in efficient condition in readiness for forced runs to any threatened point, the value of fuel economy at low speeds becomes minimized and, where the maximum speed of the vessel does not exceed 21 to 22 knots, either turbines or reciprocating engines may be used, the choice being dependent upon other factors than economics, which are practically equal at these speeds.

In other words, for the conditions (*b*) and (*c*), under which the American battleship fleet operates, the reciprocating engine is preferable to the turbine as a propelling engine at the present stage of turbine development.

The Navy Department is, however, thoroughly alive to the advantages to be gained by adopting rotary in place of reciprocating motion in the main propelling machinery of the heavy vessels of the fleet, and, while recognizing the present advantages held by the reciprocating engine in the matter of economy at low fractions of designed power, holds itself ready to discard the reciprocating engine as soon as the turbine designers can demonstrate by actual performance that their claims as to equality of economy at low powers with the older machine have been realized. It was with this object in view that the department decided to install impulse turbines in the *Nevada,* and not because the engineers of the department were "wobbling," as has been charged.

Condition (d)—Ease of Up-keep of Machinery.—The claim is frequently made by the turbine advocates that while the

* From a paper read before the Society of Naval Architects and Marine Engineers, New York, November, 1912.

reciprocating engine, when new, is undoubtedly more economical than the turbine at small fractions of designed power, this advantage is soon lost in active service, due to excessive wear of piston and valve rings causing large losses through heavy leakage of steam. The turbines, not being subject to such frictional wear, would, on the other hand, retain their original economy indefinitely.

Practical experience with both types of engine in actual service comes very far from justifying this conclusion. In fact, with intelligent supervision, the reciprocating engine, particularly since forced lubrication has been applied, holds its superiority continuously.

When reciprocating engine vessels visit the navy yards for their regular overhaul, the work to be done on the main engines is practically nil, as the machine shops and foundries of the battleships are of ample capacity to take care of all repairs that may be necessary except such as the fitting of a new cylinder or the repair of a fractured bed plate. The above remarks apply only, however, to ships fitted with forced lubrication, where the wear of bearings and journals has been practically eliminated.

When we turn to the turbine engines, however, the case is quite the opposite. Fully 99 percent of the troubles that occur with this type of engine are internal troubles, and consist of erosion of blades and nozzles, stripping of blading, heavy corrosion of rotors, diaphragms and turbine wheels, causing destruction of balance. All of these troubles require a perfectly smooth haven in which to make repairs, and the majority of them require dock-yard facilities.

In the cases of the main engines of the three scouts—*Birmingham, Salem* and *Chester*—the *Birmingham,* with reciprocating engines, has always been ready for service, while her two sisters have been repeatedly laid up at the yards for overhaul of the main turbines.

Evidence of experience leads to the conclusion that a battleship fitted with reciprocating engines for propelling purposes is much less apt to be forced off her station by necessary repairs to her engines than is one fitted with turbine engines.

Condition (e)—Reliability of Machinery when Driven at High Powers.—From the natures of the two machines, it would appear to be safe to decide this condition as being distinctly in favor of the turbines, as this type of engine is completely free from all reciprocating parts held together by bolts and nuts.

Experience with the *Delaware's* engines, however, lead to the conclusion that where proper care is taken to lock all nuts securely, and to effectively protect the engines against the shocks of reversal of direction of motion, the reciprocating engine can, even here, be regarded as nearly on a par with the turbine in reliability.

The full-power twenty-four hour run of the *Delaware,* made without preparation immediately after her arrival home from Chili, demonstrates this reliability of the present type of battleship engines very thoroughly. As stated, without any preliminary preparation of engines or machinery, the vessel put to sea, and upon getting well clear of the land a full-power run of four hours was started, during which time the vessel averaged 21.86 knots. Without intermission the vessel continued on for twenty hours longer, averaging for the full twenty-four hours a speed of 21.3 knots, the ship automatically slowing down as the fires became dirty and the personnel fatigued.

Upon the completion of the trial a radiogram was received from the commanding officer of the vessel reporting that not the slightest disarrangement had occurred to either the main engines or the auxiliary machinery, and that she was ready for immediate service.

Condition for Minimum Weight and Space Required for the Propelling Machinery.—As already shown, the total heat units required to be absorbed by the boilers, both for Parsons turbines and for reciprocating engines, with battleships of the speed and power that now exist, is practically the same in both cases at full power. This indicates that, for existing conditions, nothing can be saved in the boiler-room weights or space by adopting turbines, as the same boiler power is required in the two cases.

In the engine rooms, for these powers, however, the reciprocating engine has a decided advantage in both weight and space required.

Thus, in the *Delaware, North Dakota,* and *Utah* the engine room weights and space required are as follows:

	Delaware.	*North Dakota.*	*Utah.*
Engine-room weights, dry tons	728.26	731.23	864.69
Engine-room weights, wet tons	773.26	785.93	919.80
Engine-rooms, length, feet	44	44	60
Engine-room total width, feet	50.5	50.5	51
Engine-room, square feet, floor space	2,222	2,222	3,060

While the turbines of the *North Dakota* appear to be about on an equality with the reciprocating engines of the *Delaware* in the matters of weight and space, these turbines were extremely uneconomical. Modern turbines of this type would require an engine room more nearly equal in length to that of the *Utah,* and the engine-room weights would be considerably increased.

While the reciprocating engine has a decided advantage in the features of weight and space required, under present conditions, these advantages would disappear should the necessary power to be developed be increased considerably above what is now asked for, and the advantages would rest with the turbine. Should such an increase of power be called for in future designs, or should the ordinary cruising speed be made considerably higher than now used, the Navy Department would undoubtedly abandon the reciprocating engine and adopt one of its rotary rivals for the propulsion of its capital ships.

Condition (g)—Efficient Propellers for Maneuvering.—In considering this condition, the relation of the backing powers of the vessel as compared with the maximum full power ahead, and the time required from full speed ahead until the vessel is dead in the water, will be taken as a comparative measure of this condition.

From curves of indicated horsepower for backing for the *Delaware* (reciprocating engines) and of shaft horsepower for backing for the *Salem* (turbine engines), it is found that at low powers where more boiler power is always available than is necessary for the actual ahead speed being used, the backing power exceeds very considerably the ahead power in use, as when backing for short periods the throttles can be opened wide and the boiler power available be made use of.

When all boilers are in use, which in the case of the *Delaware* occurs at 25,000 indicated horsepower for the main engines in the ahead motion, and for the *Salem* at 14,000 shaft horsepower for the main engines in the ahead motion, the maximum backing powers can be obtained. In the case of the *Delaware* this maximum backing power amounts to 89.2 percent of the ahead power, while in the turbine vessel *Salem* it amounts to only 41.9 percent. That is, at these points, the backing power of the *Delaware* is 2.13 times as great as that of the *Salem* (both being expressed as fractions of the ahead power).

At the maximum powers developed by the engines of the two vessels, the ratio of the percentage backing powers becomes: *Delaware* = 2.27 *Salem.*

These results are further corroborated by the backing tests of the *Delaware* and the *Utah* upon their preliminary acceptance trials, where, with the *Delaware* going ahead at 21 knots and the *Utah* at 20, the times taken to bring the vessels dead in the water were, for the *Delaware,* 1 minute 52 seconds; *Utah,* 4 minutes 44 seconds.

	Delaware.	*Utah.*
Backing power divided by ahead power...	87.5 percent	35.7 percent

These results are still further corroborated by the destroyers. These vessels can easily steam ahead at 16 knots under one boiler, but when called upon to maneuver they invariably, as a matter of safety, start a second boiler.

Conditions (h) and (i)—Minimum Vibration of Hull; Steadiness of Hull as a Gun Platform as Affected by Machinery.—In judging these points it seems only fair to base the decision upon the results of target practice of the vessels in service. If this is done, the decision could be given to the reciprocating type of machinery, as the *Delaware* has just won the championship of the battleship fleet, with the *Colorado,* another reciprocating engine vessel, standing second on the list. From these results it appears reasonable to state that, with well-balanced reciprocating engines, no ill effects on gun fire should be expected.

Conclusions

Basing the choice between reciprocating engines and turbines for battleship propulsion under existing conditions of speed and power upon the above comparison of relative advantages of the two types, the advantage appears to rest most decidedly with the reciprocating engines, and the Navy Department has ruled accordingly.

Combination System

In the search for economy of propulsion through a wide range of speeds, various combinations of reciprocating engines and turbines have been proposed, both by the Bureau of Steam Engineering and by the shipbuilders, but only one of the systems has as yet been authorized, and that one is for destroyers. It had not yet been tried out in service, but preliminary shop tests show a good gain in economy of the main propelling engines at cruising speeds. This system, as applied to the destroyers, depends entirely for its gain upon the greater efficiency of the reciprocating engine at the higher steam pressures over the efficiency of high-pressure turbines of the reaction and the high-pressure nozzles of the impulse type of turbines, no advantage being gained from increased efficiency of propellers, as the reciprocating engines are on the same shafts as the turbines. From some points of view this combination is undesirable, and the gain in service must be considerable to justify its retention.

With the other combination systems proposed, calculations indicate that if the propulsive efficiency counted upon can be obtained, these systems will all be very much more efficient than either a straight turbine or straight reciprocating engine drive at maximum power, will hold a big advantage over the straight turbine drive through all ranges of powers, and will hold its advantage over the straight reciprocating engine drive until a minimum speed of about 11 knots is reached, when the efficiencies become equal.

The "if" exists, however, and is caused by the danger of the currents thrown to the rear by the big reciprocating engine screws seriously affecting the rate of feed and direction of flow of water to the turbine propellers. In addition, there may possibly be another source of loss due to heavy leakage of steam through the large change valves which must be fitted to control the paths of flow of the exhaust steam from the reciprocating engines.

In all of these systems, to adapt them to naval requirements, it is necessary to exhaust from the low-pressure cylinders of the reciprocating engines at a pressure of not less than 25 pounds absolute, when this engine is operating at full power, and to by-pass as few of the stages of the turbine as possible in order to obtain an increased economy of propulsion through a large range of powers.

Turbine Changes to Produce Increased Economy

The Parsons turbine as it exists in our vessels to-day is, with very few exceptions, the same as the turbines of this type which were fitted in the initial turbine vessel, the *Chester.* The only improvements which have been made consist of changes in blade angles, particularly in the low-pressure stages, an increase in the number of rows of blades in these same stages, and the fitting of nozzles for the admission of auxiliary exhaust steam at several different locations along the steam path.

With the impulse turbine, however, the advance over the original naval turbines of this type, those of the scout *Salem,* has been rapid. The number of stages has been very much increased, both in battleship and in destroyer turbines, a drum construction has been adopted for the lower-pressure stages, steam balance for propeller thrusts has been provided, cruising nozzles for low fractional powers have been fitted, and nozzles for utilization of auxiliary exhaust are now supplied as in the Parsons turbines.

That these changes in turbines of the impulse type have been accompanied by increase in economy has been thoroughly demonstrated by experience with the machinery of the destroyers, the economy of the impulse turbine showing up nearly, if not fully, as good as that of the reaction type. No opportunity has as yet been offered to obtain a measure of this economy increase with the battleship types of impulse turbine, nor will such opportunity occur until the *Nevada* is ready for trial.

Improvements in Reciprocating Engines Tending Towards Increased Economy and Reduction in Weight

The steps taken in pursuit of the above objects are:

1. Increase in steam pressure at engine.
2. Change in design of engine framing.
3. Increase in piston speed.
4. Use of superheat, but to a small degree only.
5. Reduction of clearances in cylinders.
6. Decrease of frictional losses through steam ports.
7. Positive circulation of steam through steam jackets.
8. Reduced back pressure in low-pressure cylinders.
9. Increased ratio between low-pressure and high-pressure cylinders, with consequent increased ratio of expansion of steam.
10. Application of forced lubrication to all journals, crosshead guides, eccentrics and thrust bearings.

While the following improvements, both with reciprocating engines and with turbines, have been made:

11. Improved condensing apparatus resulting in higher vacuum.
12. Rational designs of feed heaters based upon amount of water to be heated and amount of auxiliary exhaust steam available for heating purposes instead of using the old rule of thumb of allowing a fixed number of horsepowers per square foot of heating surface.
13. Basing steam-pipe design upon actual rate of flow of steam through the pipes as determined by tests in service.
14. Reduction of feed-pipe losses to a minimum.
15. Improved evaporators and other auxiliaries.

In addition to the above, the reliability of the machinery plant has been improved by

16. Adoption of high-speed, electric-driven forced-draft fans for battleships.
17. Turbine-driven forced-draft fans for destroyers, and the most important of all,
18. The adoption of oil fuel for both battleships and destroyers.

Considering the above changes in detail, the steam pressures at the main engines since 1895 have been increased

gradually from 150 pounds per gage to 265 pounds per gage in the high-pressure valve chest, resulting in decreased size of engine cylinders and in decreased size of steam piping for equal units of power.

The engine framing of the vertical engines first fitted was either of cast steel or built up of steel plates. On several vessels trouble has been experienced with this type of framing, particularly when made of cast steel, and, in addition, the weight was high. The Bureau of Steam Engineering, in order to overcome these faults, designed and adopted a built-up framing of forged steel for the *Kearsarge* and *Kentucky,* and this style of forged steel, built-up framing has been adhered to.

Since the adoption of this type of framing, framing troubles are unknown, notwithstanding the fact that the weight of the modern framing per indicated horsepower has been reduced to about 3.3 pounds against 5½ pounds for the old.

Since the design of engines for the *Oregon* were laid down, there has been a gradual increase in piston speeds used, from 900 feet in that class to 1,000 feet in the *Delaware* class. This increase in piston speed has been followed by decrease in weight of the moving parts and has aided in holding down the weight and height of the engine, although the stroke has been increased from 42 inches to 48 inches.

In the use of superheated steam, the Bureau of Steam Engineering has been rather conservative; at present there are seven vessels in the naval service fitted for superheat, the maximum degree of superheat obtained at the boilers being 85° F., which reduces to about 60° F. at the engines. These figures are for full-power conditions, and an increase in economy of about 6 percent is estimated to be obtained. At 12 knots, the cruising speed, the saving by the use of superheat hardly exceeds 3 percent.

The first experiences with the vessels fitted with superheat were far from satisfactory, due to the rapid deterioration of the valves in the steam lines. These valves had cast-steel bodies and cast-steel valve disks with monel metal seats. The erosion and corrosion of the valve disks was very extensive, and in a short period of service it became necessary to replace the cast-steel valve disks with disks of monel metal. This substitution has been satisfactory and no further trouble has been experienced.

The superheat has been used only on battleships fitted with reciprocating engines or impulse turbines for propelling purposes and has not as yet been used on any of the destroyers.

Reduction of clearances, decrease of frictional resistances of steam through the steam ports and reduced back pressures in the low-pressure cylinders have all resulted from one very important change in the design of engine cylinders and valve chests by substituting for the long-tortuous port a short direct port.

The result obtained by this change can best be shown by the following table of comparison of cylinder clearances and steam velocities:

Diameter of cylinders, inches:	Old Type.	New No. 1.	New No. 2.	New No. 3.
H. P.	32½	38½	32	35
I. P.	53	57	52	59
L. P.	2—61	2—76	2—72	2—78
Stroke of pistons	48	48	48	48
Percent clearances:				
H. P.	28	16.17	13.83	13
I. P.	20.8	13.17	12.65	13½
L. P.	18.5	12.485	12.02	12
Steam velocity, feet per minute:				
H. P.	5,670	6,565	6,723	6,402
I. P.	8,262	6,678	7,883	7,517
L. P.	10,833	10,446	9,947	10,281
Exhaust velocity:				
H. P.	5,480	5,340	5,289	5,078
I. P.	6,670	6,180	5,909	6,087
L. P.	7,450	7,514	7,199	7,298
To condenser	7,390	6,937	6,612	6,500

In the last ten years the cylinder ratio of low-pressure to high-pressure, for triple expansion engines, has been increased from about 7 : 1 to 10 : 1, including clearances. This increase in ratio had been used previously in remodeling the engines of the *Cincinnati* and *Raleigh,* with most excellent results. A serious mistake was made, however, in counting too much on the increased expansions obtained by fitting a smaller high-pressure cylinder than that originally installed, the steam pressure having been increased. The new high-pressure cylinder was made 24 inches in diameter and the ratio of low-pressure to high-pressure cylinder changed to about 11½ to 1. While the economy obtained with these engines was most excellent, the high-pressure cylinders were entirely too small and the engines have never developed the expected power.

By the adoption of forced lubrication for the main propelling engines, the engine friction has been enormously reduced. All the journals are oil borne, so that no metal to metal contact occurs. The result has been that the amount of adjustment and overhaul of the main engines has been decreased to a very large extent, and the men who would have been used for this overhaul work can now be used on the auxiliary machinery to good advantage. This decrease in wear of the bearings, and the cushion provided by the oil, has resulted in a much better maintenance of alignment of the engines, has reduced shocks on the machinery and has reduced vibration due to these shocks.

In addition, there is considerable saving in oil at ordinary speeds. At high speeds there still exists a heavy loss of oil, due to splashing on the cylinder heads and also to loss by evaporation from the hot surface of the lower heads.

When first fitted, the forced lubrication gave trouble, due to oil being drawn through the low-pressure piston-rod stuffing boxes. In order to remedy this defect, stuffing boxes fitted with steam seals have been supplied, and later reports indicate that where the steam seal is properly fitted no trouble of this kind now exists.

That the foregoing changes have produced great economy is amply demonstrated by the results obtained with the machinery installations of the *Michigan, South Carolina* and *Delaware.*

With the advent of the turbine for marine propulsion, if the full benefit of the new machine was to be realized, a high vacuum in the condensers became imperative. In order to obtain such vacuums, the Parsons Company originated the vacuum augmentor, and this addition to the condensing plant is used extensively in the naval service. In some vessels in the service, in place of the ordinary air pump with augmentor, air pumps of the dual type, as manufactured by Weir, have been fitted, while in other vessels both wet and dry air pumps have been used.

Of these systems, that with augmentors and also the dual type appear to give the greatest satisfaction in service, and in addition require less weight and space than the wet and dry system. Abroad, a new system, known as the "Kinetic," has been developed, and all reports received concerning it have been very favorable, but no example of this system yet exists in the American naval service. In conjunction with these improved systems has occurred an improvement in the tube spacing and the baffling of the condensers in order that a better separation of air from the water of condensation will occur in the condensers.

The improvements in design of feed heaters, steam pipes and feed pipes naturally followed on the measurements of water consumptions of the machinery taken during the acceptance trials of the vessels. These measurements placed in the hands of the Bureau of Steam Engineering data of great value, and that bureau has attempted to use the full value of it in proportioning these important items.

For instance, the feed heaters of the Delaware were, for lack of data, proportioned on the basis of so many indicated

horsepower per square foot of heating surface, and the two heaters combined have a total heating surface of 2,100 square feet. In her sister ship, the *Utah,* the same degree of feed heating is obtained with heaters having a total surface of only 512 square feet.

In the search for economy, the Bureau of Steam Engineering has adhered strenuously to the use of feed heaters with auxiliary exhaust steam as the heating medium, using any excess of exhaust in the low-pressure turbines or the second receivers of triple expansion reciprocating engines. This utilization of the auxiliary exhaust has not been to the taste of the turbine manufacturers who prefer to use all of this steam in the turbines, depending for feed heat upon that derived from steam drains discharging into the feed tanks.

The improvements in evaporators consist mainly in the adoption of double effect connecting and in throwing open the gates to other than the standard bureau design, although these are not the only changes from former practice. Evaporator feed heaters using the vapor from the evaporators as a heating medium have been fitted, and vapor pipes, better designed for the amount they have to carry, are installed.

Until the adoption of electric-driven blowers for battleships and other large vessels and of turbine-driven blowers for destroyers and small vessels, the successful outcome of any heavy forced-draft run was always endangered by the unreliability of the blowers. Since the adoption of these types of blowers this danger of breakdown has been almost entirely eliminated, and, so far as the destroyers are concerned, the blowers may be classed as one of the most, if not the most, reliable of the auxiliaries fitted.

Oil Fuel for Destroyers and Battleships

In deciding to adopt oil fuel for use on battleships and destroyers, the Navy Department took into account the following advantages which would be gained by its adoption:

1. Less fuel required for any given radius of action, consequently less percentage of displacement and less bunker capacity required for the fuel.
2. Increased boiler efficiencies.
3. Decreased fire-room force.
4. Less deterioration of boilers due to maintenance of more even temperatures.
5. Ability to maintain high powers for indefinite periods.
6. Less deterioration of ship's structure due to there being no water or ashes in the bilges.
7. Greater cleanliness.
8. Greater ease in replenishing fuel supply, both in port and at sea.
9. Less floor space required for the development of a given power.
10. Greater ease in control of steam supply.

In opposition to these undoubted advantages the following disadvantages exist:

1. Fuel oil less widely distributed over the earth than coal.
2. Greater unit cost than coal.
3. Greater danger of fire than with coal.

The reply to the first disadvantage is that in time of war a fleet operating far from a base would depend upon fuel ships for replenishing her bunkers, and that oil can be carried in bulk as well as coal, and bases where stores of oil can be kept on hand are as easily established as are bases for coal, and such oil bases would have, in case of danger of capture by an enemy, the additional advantage of being much more readily destroyed, together with their stores of fuel, than are coal bases.

The second disadvantage, that of excess cost over coal, is more than compensated for by the quoted advantages.

The third disadvantage, that of danger from fire, is very thoroughly guarded against by storing the oil in compartments remote from the boiler rooms, and situated well below the waterline of the vessel. In addition to these primary precautions, additional safeguards are provided which render the danger from fire fully as remote as the danger from magazine explosions.

Upon deciding on the adoption of oil as a fuel for the naval service, the Bureau of Steam Engineering examined carefully all the systems for burning oil that now exist and finally decided upon that of mechanical atomization of the oil as the one most suitable for naval use.

In this system, the oil is pumped through heaters to the burners, within which it is given a whirling motion. The small central core of oil, discharging through the tip orifice with this whirling motion, the oil flies off and forms a cone of fine mist. This oil mist mixes thoroughly in the furnace with air which passes into the furnace through a cone register surrounding the burner, the register having adjustable openings and guide vanes so that the amount of air to each burner may be regulated and the direction of flow of this air be slightly oblique to the axis of the cone of oil.

The success of the system depends almost entirely upon the proper handling of the air. Improper air regulation will produce a series of rapid explosions of oil in the furnaces with consequent destruction of the brick linings of the furnaces. With proper handling, the oil burns almost noiselessly, and the amount of smoke produced can be held absolutely under control.

In the first battleships fitted with oil fuel, the oil was only fitted as an auxiliary fuel and was intended to be used as an aid in keeping up steam when the coal should be so low as to be remote from the fire-rooms and so require excessive trimming. The results obtained with this mixed system are not to be rated as good nor were good results expected, as the furnace volumes of coal-burning are too small to permit efficient burning of oil. Furthermore, when burning the oil and coal in combination it is impossible to so regulate the air supply that each fuel will obtain the proper amount. This results in excessive production of smoke and no increase in steam production over coal alone.

Conclusion

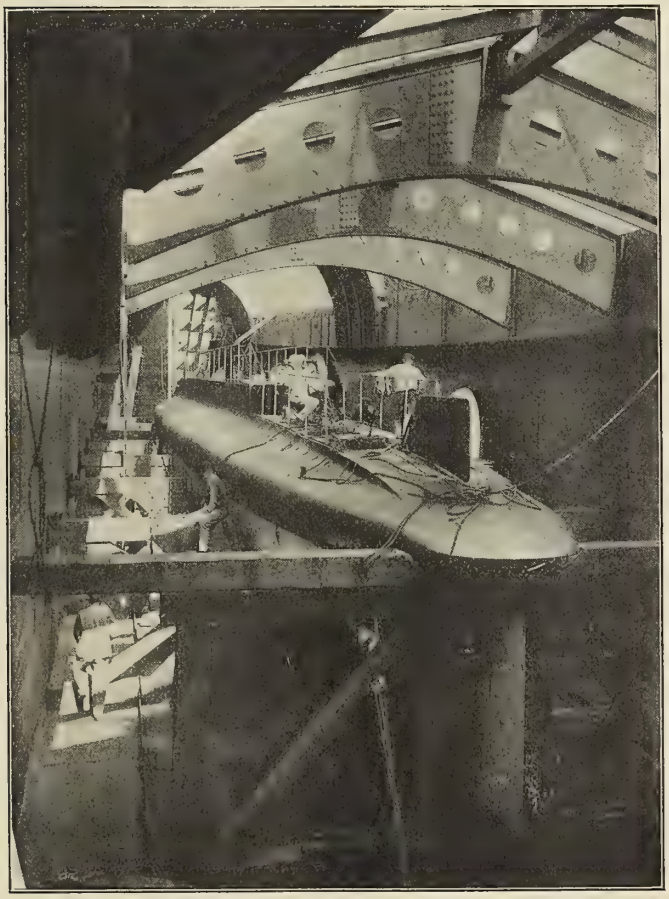
With such a large field to cover as suggested by the title of this article, the limitations as to length of the article prohibit anything more than a brief discussion of each point considered, but it is hoped that what has been presented will assure the Society of Naval Architects and Marine Engineers that engineering progress in the naval service has not ceased, and that the Bureau of Steam Engineering, greatly assisted by its co-workers in the development of the navy—that is, the other technical bureaus of the Navy Department and the engineers of the various shipbuilding yards engaged in naval work—is to-day at least as progressive and as free from ultra conservatism as it has ever been in its history.

New German Shipping Rules.—New rules for ocean-going steamships were approved on Oct. 28 at a conference held at the German Ministry of the Interior, at which representatives of the German Ministries, the Federal Council and the shipping interests were present. The new rules deal with the questions of bulkheads, lifeboats, wireless telegraphy and the reporting of icebergs. All passenger steamers carrying 75 persons, including the crew, and freighters carrying a crew of 60, must in the future be equipped with wireless telegraphy having a radius of 100 sea miles, and these vessels must carry a certain proportion of skilled oarsmen to man the lifeboats. The existing regulations as to bulkheads have also been thoroughly revised.

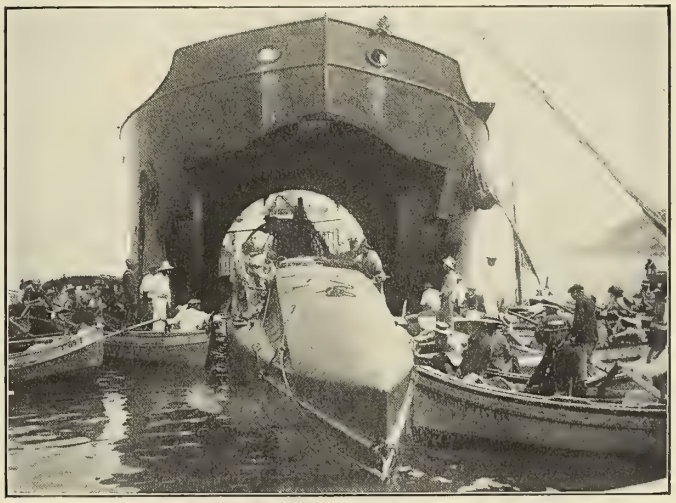
GENERAL VIEW OF THE KANGUROO WITH OPENING AT THE BOW FREE

Transport Ship for Submarines

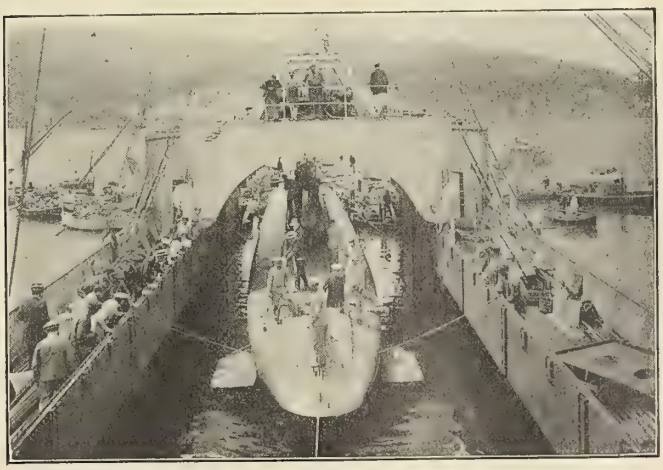
The illustrations on this page give different views of the transport ship *Kanguroo,* built by the Société Anonyme des Chantiers et Ateliers de la Gironde, Bordeaux, France, for Messrs. Schneider & Company, of Creusot, for the transportation of submarine boats on long sea voyages. The *Kanguroo* was described on page 353 of our September number. The accompanying illustrations, however, give a better idea of the method by which the submarine is placed on board the ship for transportation. For this purpose the vessel virtually becomes a floating dry dock, the forward part of the ship is afterwards closed and the vessel becomes an ordinary cargo boat.



THE SUBMERSIBLE SHORED UP READY FOR TRANSPORT



THE SUBMERSIBLE ENTERING STERN FIRST



THE SUBMERSIBLE AFLOAT IN THE KANGUROO

Notes on Fuel Economy as Influenced by Ship Design*

BY E. H. RIGG

In recent years we have witnessed great progress in marine engineering; new types are striving for first place, each having its advantages and its advocates; geared turbines, oil and gas engines, electric transmission and other schemes, each offering economies of fuel and therefore lesser operating expenses.

The latest transactions of the technical societies concerned all contain papers bearing on the subject, especially the one read before the Northeast Coast Institution last April and the one on the geared turbines on the channel steamer *Normannia*, read before the Institution of Naval Architects this year, to say nothing of many important papers read elsewhere.

These all point out the possibilities of ecenomy from the point of view of machinery savings. It is the object of these notes to point out possible economies due to efficient ship design, because savings are being made by naval architects, as well as by marine engineers.

Cheapness of operation is one of the necessities for commercial success in a competitive age. The problem of evolving economical ship forms is an intricate one, and a study of the records of this society will show that much time and money have been spent in the pursuit of efficient forms, which is another way of saying economy.

Experimental tanks have been built in all the leading maritime countries, and commerce is slowly but surely beginning to reap the benefits. Not only has ship form come in for the attention it deserves, but we have lately witnessed renewed efforts to solve propeller problems, so necessary to keep up with the higher speeds of revolution demanded by the new types of propelling machinery.

It is at once evident that the naval service has reaped the greatest benefit of the study devoted to ship propulsion; perhaps this is only natural, the pioneer experimental tank in our country being the government one at Washington. That this tank pays is evidenced by the difference between the *Connecticut* trials and those of the *Michigan*. The average ship of the *Connecticut* class required 15,700 indicated horsepower for 18 knots, whereas the later design, of identical displacement and type of machinery, required only 13,100 indicated horsepower for the same speed. This means that for 10,000 miles the saving in coal amounts to some 1,100 tons at 18 knots; this can be fairly credited to the experimental tank and its able staff.

Our destroyer designs are also good examples of efficient propulsion; the way in which the recent vessels have gone through their trials compared with those of twelve years ago needs no comment.

The best speed at which to run a merchant vessel is not a question that the builder has much to do with. The distance between ports, proportionate values of passenger and freight business, the nature of the cargo, mail-carrying requirements, character of the waters traversed, and the competition to be met are the prime factors in determining this speed. Once it has been decided upon, the builders should be allowed to settle the dimensions best suited to the speed and the work (passenger and freight accommodations) expected of the vessel. It is surprising how many vessels are run at unsuitable speeds, some unavoidably so on account of passenger accommodations; but the majority could well have been reconciled in the design stage as regards the dimensions, speed, capacity, stability, trim and deadweight.

When the owners decide on their real service speed, the builders should not be required to run a measured mile trial reaching a top speed out of all proportion to the service speed; it can only be done at a sacrifice of efficiency elsewhere, probably in the fining of the ship and consequent reduction in carrying capacity.

In fast passenger liners the proper reconciling of speed and dimensions may very well spell success or failure to the whole venture; this should be recognized and some time devoted to preliminary design work and model tank tests. The preliminary work on the *Mauretania* designs furnishes a case in point. Why should not corresponding care and attention be devoted to less ambitious designs? That many owners are seeking to get the maximum out of their investment is evident when we consider the number of special types lately coming to the front, all designed with a view to the utmost efficiency in their particular line, not only for driving but more especially for cargo handling and storage.

The following examples have been collected from recent experience in general design work, with the hope that others will be brought forward in discussion by those whose daily experience has been along similar lines.

EXAMPLE NO. 1

Advantage of model tank experiments on hull forms and of careful propeller design.

The data below can be vouched for, the two vessels being tried over the same course, Delaware Breakwater; both were deep load draft trials and progressive runs were made.

It will be noticed that the displacement of the larger vessel, the model of which was tried in the tank, is 46 percent in excess of the smaller, and the power identical at cargo vessel speeds. The larger vessel would take even less power at sea than the smaller on account of size. The first vessel is an oil tank and the second a United States naval collier of the *Mars* class.

The figures below speak for themselves:

ITEM.	Year of 1903.	Completion, 1909
Length	360 ft. 0 in.	385 ft. 0 in.
Breadth	46 ft. 3 in.	53 ft. 0 in.
Draft	20 ft. 7 in.	24 ft. 8 in.
Displacement in tons	7,700	11,260
Block coefficient	.786	.784
Propulsion, system of	Single screw	Twin screw
I. H. P. for 10 knots	1,525	1,550
I. H. P. for 11 knots	2,125	2,100
I. H. P. for 11½ knots	2,500	2,400
I. H. P. for 12 knots	....	2,800
Dead weight carried in tons	5,000	7,400

EXAMPLE NO. 2

An interesting case of extravagant design came up recently. A shipping firm had plans of an 11-knot steamer built in Europe of the following general dimensions: 400 feet by 52 feet by 34 feet. They wanted a duplicate built here, but with machinery for 10 knots only. The suggestion that the steel hull could be built 6 percent cheaper to modified dimensions without affecting the coal bill was rather a shock to the prospective owners. The vessel as redesigned, with identical deadweight, draft and cargo capacity, worked out at 370 feet by 54 feet 6 inches by 35 feet. The power worked out as follows:

ITEM.	400-Ft. Ship.	370-Ft. Ship.
Skin E. H. P.	685	645
Residuary E. H. P.	365	405
Total	1,050	1,050

These are for 10 knots in each case. In addition to less first

* A paper read before the Society of Naval Architects and Marine Engineers, New York, November, 1912.

cost, the shorter boat will be handier at sea, more easily taken care of as regards stability, and occupy less space at piers. There was no question of repeating an order.

Example No. 3

In heavy bulk carriers it is desirable to know how full a vessel can be made, keeping capacity down and so having no more ship than is necessary. A majority of ship designs on this coast are prepared for light cargoes occupying large space, where ship dimensions run large per ton deadweight; hence the saving in ship dimensions possible when carrying ore, for instance, is apt to be overlooked.

These vessels are frequently run at only 9 knots, even though they have some margin of power; the problem resolves itself into one of finding the range of dimensions where the total resistance remains constant, even though the component parts vary. In a design to carry 7,000 tons deadweight it was found practicable to increase block coefficient from .75 to .78 and reduce length from 360 to 340 feet for the same effective horsepower at 9 knots; this represented a 5 percent saving in steel hull. Beam and draft remained constant.

This problem and the preceding one are merely examples of searching for the economical limit of speed, on which subject a good deal has been published from time to time.

While the temptation to keep power down by fining the ship is a strong one, especially when owners expect a very low coal per diem rate, ship designers should never allow the dimensions to run up beyond what this somewhat elusive economical limit requires.

Example No. 4

Quadruple expansion machinery versus triple for long voyages.

The author recently had a very forcible example of the saving possible if quadruple expansion machinery were fitted in a cargo steamer designed to carry 7,000 tons of paying freight for a distance of 14,000 miles, oil burning. The figures came out as follows:

Item.	Quadruple.	Triple.
Length	400 ft. 0 in.	410 ft. 0 in.
Breadth	53 ft. 0 in.	53 ft. 0 in.
Draft	27 ft. 0 in.	27 ft. 0 in.
Ship, tons	4,125	4,160
Cargo, tons	7,000	7,000
Oil, crew and water	1,900	2,200
Displacement	13,025	13,360
Speed, knots	11	11
I. H. P.	2,750	2,800
Savings per voyage	$2,500 (£510)	....
Extra first cost	$10,000 (£2,050)	....

It will be seen that the extra first cost is recovered in four voyages, and after that a steady gain per voyage is apparent. This is not strictly an example of economy due to ship form, but has been inserted as being perhaps of interest.

Example No. 5

From the point of view of economy due to machinery, it can be shown that single-screw propulsion is cheaper than twin screw, the advantage of twin screw being in greater immunity from breakdown, a point by no means negligible in passenger and perishable cargo ships. This is well known to the members of the Society, and is only mentioned to make the examples more complete.

Example No. 6

Recently published photographs of our latest battleships in dry dock reveal a peculiar bulbous form of bow, the load waterline being narrowed and the displacement made up by filling out the lower waterlines. Experiments at the model tank in Washington show a material saving due to this form, the bow waves being naturally lessened by the fine upper waterlines.

The superintendent of one of our coastwise lines of steamers has had the courage to adopt this form of bow for a 12-knot cargo steamer, in which a 3 percent saving would mean a ton of coal per diem, a by no means negligible amount when figured in dollars per annum. It is to be hoped this will be realized in service.

Example No. 7

It is well known that river steamers at certain speeds and in certain drafts of water create excessive waves, causing bad erosion of the banks, besides damage to shipping.

A firm of owners recently had conducted for them experiments with several models to see what could be done to reduce this wave under their operating conditions. The tank finally showed them the best lines on which to lay down the vessel for minimum wave-making, the speed being obtained with less power in addition. This also reduced the slowing up necessary to prevent damage to shipping along the banks. The top speed was obtained in deep, smooth water for less power with the model that gave best results in shoal water. The vessel is 410 feet long and of 8 feet draft.

In 20 feet of water a saving of some 5 percent resulted at working speeds. At low and moderate speeds up to about 18 knots, the best model for shoal water was the worst in deep water, but this could well be ignored in a river steamer.

Example No. 8

A sound steamer of wide beam relative to draft, having flared guards. The plans submitted for bids had a midship section which, while good for stability, seemed to be capable of considerable improvement from the point of view of the coal pile. Recognizing the necessity of keeping the same stability, a fuller midship section was designed. At the expense of 2 percent increase in the shell and framing of the vessel, an 18 percent saving can be made in the coal bill; in other words, the improved lines would cut the power from about 2,750 to 2,250, indicated, at 16 knots on a deep-water mile trial. The vessel was 270 feet long and of some 2,250 tons displacement.

Anyone who keeps up to date with the transactions of this and kindred societies will know what valuable original research work has been placed on record during the last few years. These notes make no claim to originality, but merely attempt to show, from the point of view of the practical designer of ships, the results presented in another form by our fellow designers working at experimental tanks and in colleges along more purely scientific lines than are possible at a shipyard, where the contract delivery date generally places a strict limit on the amount of preliminary investigation possible before the design has to take concrete form in the mold loft and the shops.

Tests of Corrugated Hulls.—Naval Constructor David W. Taylor, U. S. N., will conduct a series of tests on models of ships with corrugated sides at the Washington navy yard during this winter. Four merchant ships of this type have been built in England and proved successful. It is expected that the same idea might be applied to battleships with a marked saving in propulsive power. Two outward curves, 23 inches deep, run the length of the ship between the load waterline and the bilge. Between the convex curves is a concave surface of equal depth. This partial application of the tube principle greatly increases the strength of the hull as well as increasing the propulsive efficiency of the vessel.

An Electrically Propelled Fireproof Passenger Steamer*

BY WILLIAM T. DONNELLY AND GEORGE A. ORROK

The plans herewith submitted show a vessel 275 feet long over all, 260 feet on the waterline with an extreme beam of 68 feet and a molded breadth at the waterline of 45 feet 8 inches, designed to have a displacement of 1,714 tons on a draft of 10 feet. The hull is designed to have a double bottom for a length of 188 feet and double sides carried up to the deck for a length of 109 feet, corresponding to the machinery and boiler space. It is also intended to make the coal bunker space on each side of the boilers with semi-watertight doors, which will add a large additional factor of safety. The design provides for seven watertight bulkheads carried up to the deck and there is no provision for openings; that is, so-called watertight doors through bulkheads are to be entirely eliminated.

By referring to the general design elevation it will be seen that the vessel is to have three full decks and that the pilot-house and officers' quarters comprise a fourth.

The boiler space is divided by watertight bulkheads into two fire-rooms, and the boiler casing is carried up through the center of the superstructure. The engine-room space is also surrounded by steel housing in such a way as to prevent the possibility of steam escaping into the passenger space.

The superstructure and decks are to be built entirely of light steel, no wood being used except as a guard strip on the outside, and with this construction it will be practically impossible to start or maintain a fire in any part of the boat.

Attention is called to the detailed design for the steel deck, in which very light plates are used running across the vessel, with their edges flanged and united to steel carlins. The upper surface of the plating is to be covered with canvas, which makes a watertight and weather-proof joint where the plates meet. The carlins are to be supported by 6-inch steel I-beam stringers carried on steel pipe stanchions. It should be here mentioned that these steel pipe stanchions and steel stringers under carlins are now in use on the highest class of river passenger boats.

At the present time all steam engines are controlled by the engineering staff through signals from the pilot-house. In the case of the electrically-propelled steam vessel this double control, involving a signal between two parties, will be eliminated, the operating staff would deal solely with the production of the power, and the use and control of the power be centered in the hands of the executive officers of the ship, as it clearly should be. To this division of responsibility electricity lends itself in a marvelous way.

Granting the broad application of electric generation and propulsion to steamships, we have before us new conditions altogether unexpected and surprising. In the *Grand Republic*, a steamer in comparison with which the plans herewith are submitted, we have a vessel in use for not more than four months in the year. For the remaining eight months we have an investment totally incapable of any use. In the power plant of the steamer here shown we have a generating plant of 3,000 horsepower, which can deliver itself to any location on navigable water and deliver 3,000 horsepower in electric energy utilizable for any possible purpose, either for light or power, and if this system were to be applied to a freight steamer it is equally apparent that instead of the power plant of the steamer being useless when in port all the power would be available for handling cargo or for any other purpose.

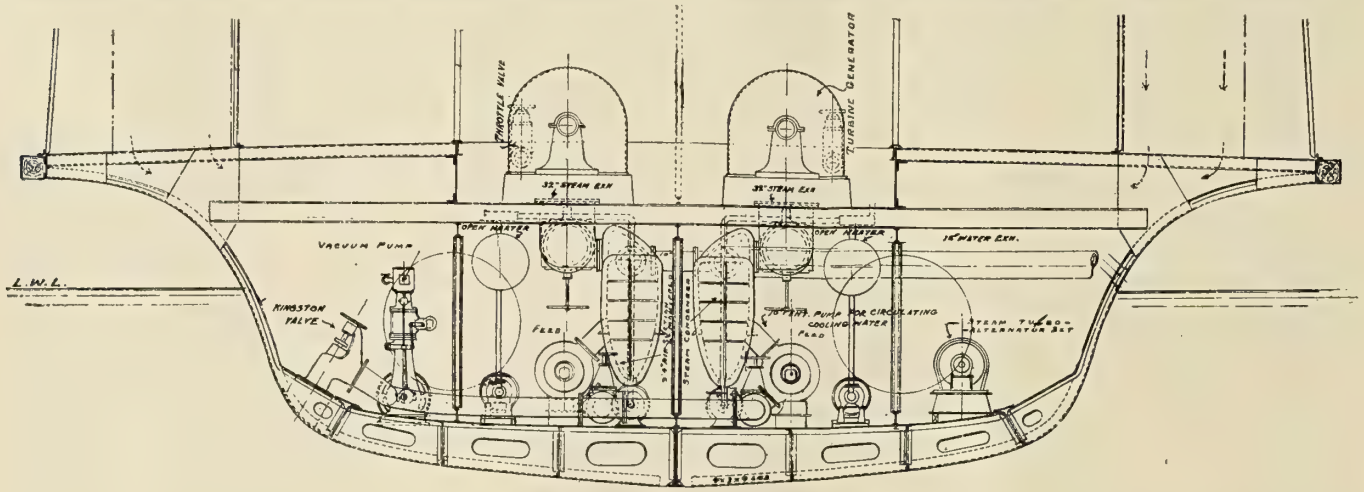


FIG. 1.—SECTION THROUGH ENGINE ROOM

The design of the machinery for the vessel whose plans are here presented has been treated from the viewpoint of the central station, the control of the motors driving the three shafts being in the pilot-house, making the load on the leads to the motors (corresponding to the load on the feeders) as independent of the generating apparatus as in a power station. The generating units are standard pieces of apparatus, generously proportioned for continuous service, which have been developed to meet the exacting conditions of central station lighting service. They are provided with an automatic oiling and water-cooling system and the various attachments which have been proved necessary to insure the required regularity of operation.

The two units, 1,500 kilowatts, 80 percent power factor, maximum rating, are located side by side on a specially constructed portion of the main deck in a glass enclosure where suitable ventilation may easily be secured for the generators. Each turbine has an exciter direct connected on the main shaft, and the exciter regulation is automatic in its character, only requiring attention during the starting and stopping of the unit. One 25-kilowatt, steam-turbine-driven, independent exciter is also installed for starting up and to furnish lighting for such times as the main units are not in operation.

Directly below the turbines are the condensers, each of 3,000

* From a paper read before the Society of Naval Architects and Marine Engineers, New York, November, 1912.

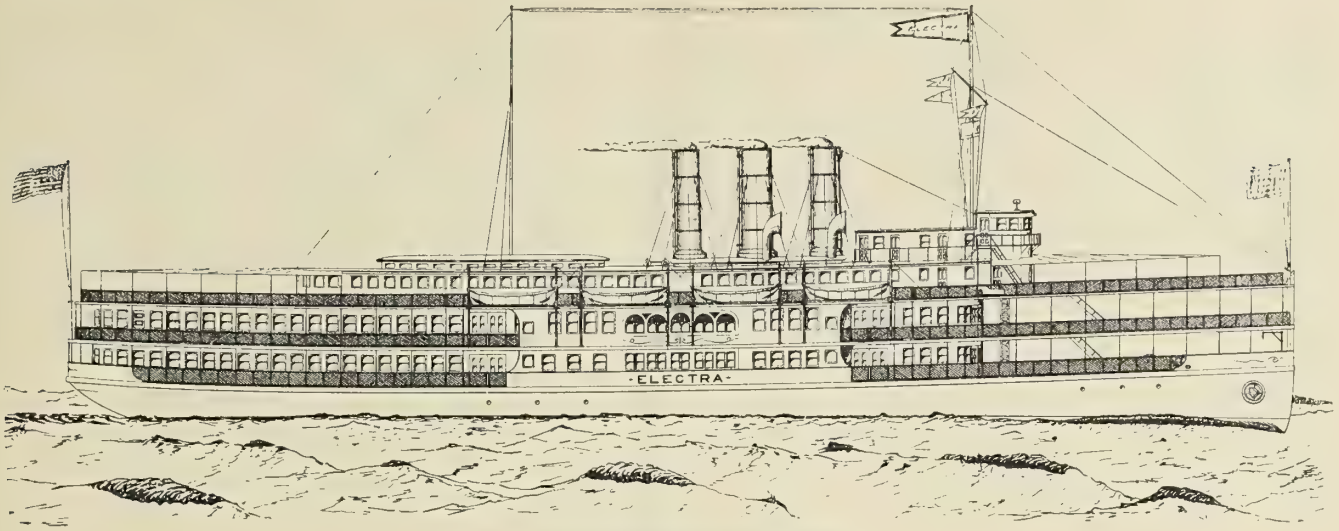


FIG. 2.—OUTBOARD PROFILE OF THE ELECTRA

square feet surface, with the other necessary auxiliaries, feed pumps, bilge and fire pumps, etc. The condensers are proportioned to maintain a 28-inch vacuum with the 70-degree water prevailing under summer conditions in New York harbor. The circulating pumps are turbine-driven, and under normal conditions will deliver 5,000 gallons per minute through the condensers.

The hot-well pumps are on the same shaft as the circulating pumps, and have a capacity of 150 gallons per minute against a head of 50 feet. These two pumps are of the centrifugal type and of standard design. In the wings on either side of the condensers are the two air compressors, which are also used for air pumps, and will, by a special device, discharge either at atmospheric pressure or at 10 pounds gage. Either unit, as

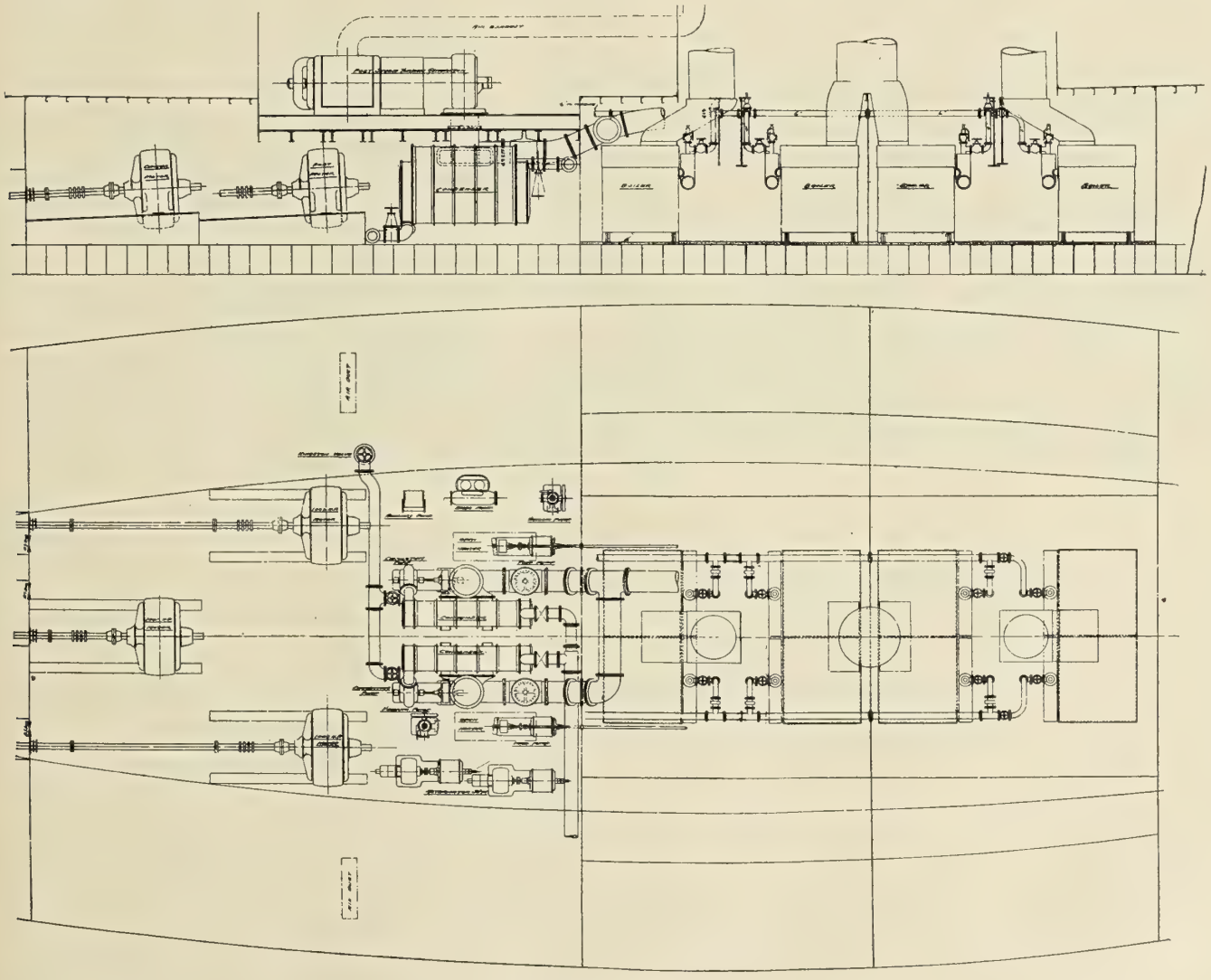


FIG. 3.—MACHINERY ARRANGEMENT

an air pump, has a capacity sufficient to handle both condensers, and the air suction pipes are interconnected.

The two turbine-driven centrifugal feed pumps are also located in the wings. Each pump has a capacity of 200 gallons of water per minute against a head of 700 feet, and one unit will be sufficient to feed the boilers except on special occasions. These pumps are run under nearly constant speed conditions, and are provided with an unloading device which by-passes the feed-water should the feed valves be entirely shut.

Two bilge and fire pumps are also provided, each of 150 minute. They are provided with collector rings and are controlled by means of varying the external resistance. The motors and generators are so designed that the current under a dead short circuit does not exceed two and one-half times the full-load current.

The controllers for the three motors are in the pilot-house, and are fitted with interlocking devices as well as an automatic timing device. All the motors may be started, brought to any speed up to full speed, reversed or stopped by the manipulation of the three controller handles, one for each motor. In addition, signaling devices are installed in both

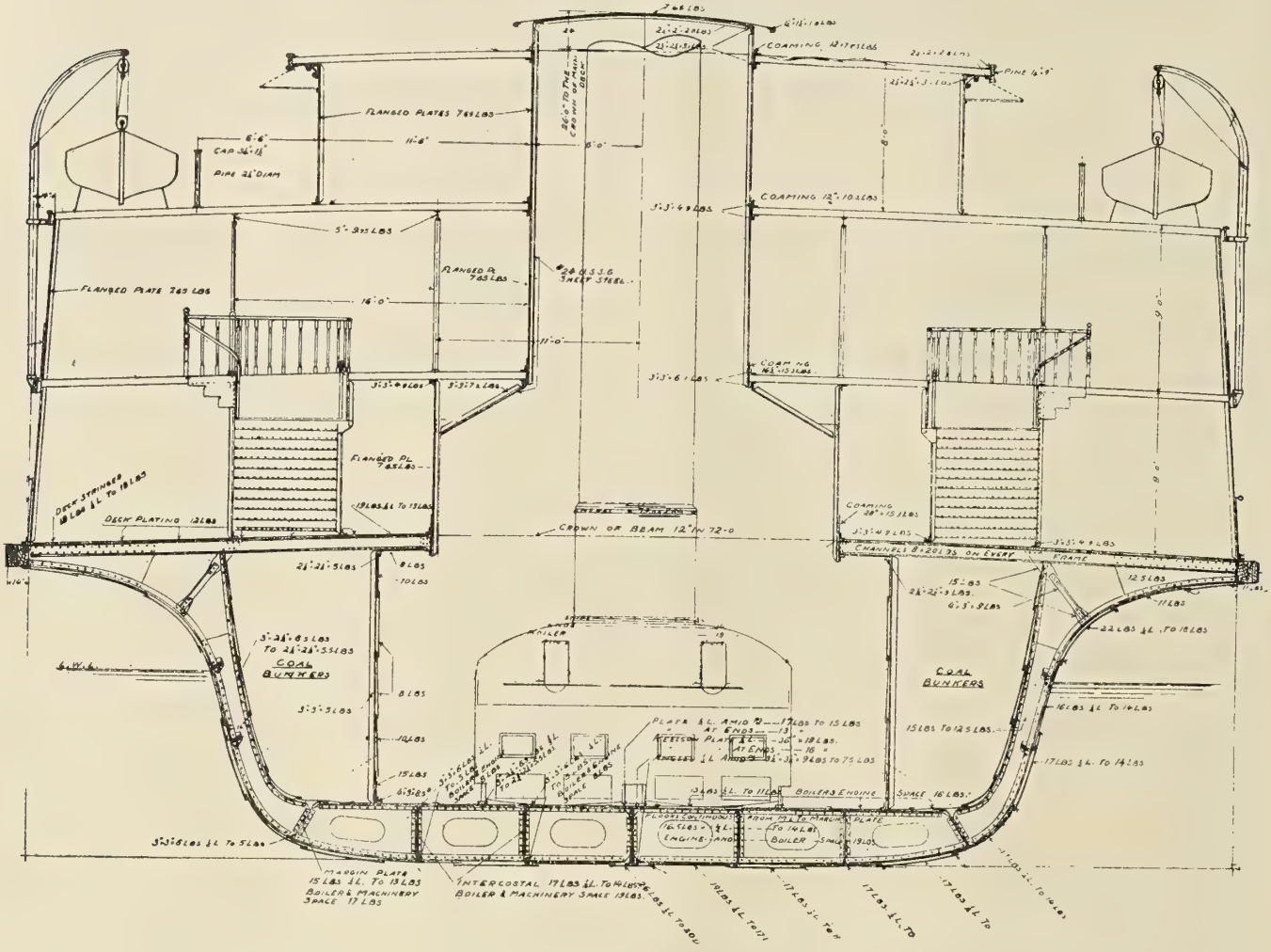


FIG. 4.—MIDSHIP SECTION

gallons capacity, and a fresh-water tank pump of 50 gallons capacity for the make-up feed from the tanks. Above the feed pumps two open heaters, each of a capacity of 50,000 pounds of water per hour, serve to heat the feed-water by mixing with the exhaust steam from the auxiliaries. The turbine-driven auxiliaries have been proportioned to furnish about 90 percent of the steam required to heat the feed-water to 208 degrees F., and a live steam connection will be provided for the additional heat should its use be desirable. Suitable atmospheric exhaust connections and valves are provided, and the auxiliary exhaust has an oil separator in front of each heater, although but little oily steam will be present, as most of the auxiliaries are turbine driven. All of the small turbine bearings are ring-oiled and will require very little attention.

Immediately astern of the condensers and auxiliaries are the three 1,000-horsepower induction motors and the thrust bearings. These motors are very generously proportioned. They have 24 poles and a normal speed of 300 revolutions per

engine room and boiler room as well as the usual bell and speaking tubes.

The fire-rooms, two in number, each containing four water-tube boilers in two batteries, are located forward of the machinery space. The coal bunkers are in the wings on either side of the batteries. Each boiler has 1,635 square feet of heating surface and 44 square feet of grate surface. The steam pressure will be 250 pounds gage, and the steam will be moderately superheated. The steam main is in duplicate with cross connections, as is the feed-water main, and both are of the highest grade. The steam piping is of steel pipe with Van Stone joints, steel flanges, fittings and valves. The feed piping is brass with brass valves and fittings. All boiler connections have two valves between the boiler and the pressure main, and the automatic stop-check valves usual in the best power-house practice will be installed. Each boiler is provided with steel, extra heavy safety valves of navy pattern.

The boilers are served by three stacks—one for the forward

pair, a large one for the middle four boilers, and one for the after pair. These stacks are 6 feet 6 inches and 8 feet in diameter and 72 feet above the grates. Forced draft has been provided for but the machinery will not be installed.

LIST OF MACHINERY

	Weight in Tons.
Eight water-tube boilers:	
Grate surface, 44 sq. ft. each....352 sq. ft. total	
Heating surface, 1,635 sq. ft. each....13,080 sq. ft. total	105.0
Pressure....250 pounds	
Main generating units:	
Two 3-phase, 60-cycle, 1,500-K. W. maximum 24-hour rating, 35 deg. C. rise, 3,600 R. P. M., 2,200 volts, 80 percent power factor	57.5
Three 1,000-horsepower induction motors, 24-pole, 300 R. P. M.	33.5
Three sets of switches and controllers	20.5
Two condensers, 3,000 sq. ft. cooling surface each	25.0
Two combination turbine-driven centrifugal pumps	
Two independent exciter sets	3.0
Two turbine-driven centrifugal feed pumps, 200 gallons each.	2.0
Two bilge and fire pumps, 150 gallons	1.5
Two tank pumps, 50 gallons	
Two air compressors for 10 pounds pressure	4.0
Steam and other piping	5.0
Two open heaters, 50,000 pounds per hour	2.0
Three propeller shafts	11.5
Three propellers	3.0
Steel foundation for supporting machinery	25.0
Total weight of machinery	298.5

All auxiliary machinery is in duplicate, and, as far as possible, turbine-driven units are used.

The total weight of the machinery, including propellers, shafting, auxiliaries, switchboard, boilers, piping and water in boilers and condensers will probably not exceed 300 tons. This figure includes the steel seatings for the generating units and motors. Considering an equivalent of over 3,000 indicated horsepower in the motors, the weight of machinery is approximately .1 ton per indicated horsepower.

Besides the saving in deck space, in this case about 4,000 square feet, by the substitution of screw propulsion for paddle-wheels, the saving in weight over the vertical beam engine type with return tubular boilers is much more marked, as the average of a number of these boats gives for the machinery weights a figure of between .20 and .25 ton per indicated horsepower.

The coal consumption of vessels of the type of the *Grand Republic* is not far from 3.25 pounds per indicated horsepower under test conditions. With the ordinary running it would necessarily be larger. The vessel here described should, under test, give results approaching 1.5 pounds of coal per indicated horsepower-hour, and under ordinary operating conditions the saving in coal alone would probably amount to about 2 pounds per indicated horsepower-hour.

Allowing steaming time of ten hours at full power per day for 100 days, corresponding to the summer excursion season, the saving in coal would amount to 3,000 tons, which at $3.00 (12/6) per ton would mean a saving of $9,000 (£1,850), and this amount, capitalized at 10 percent, would warrant an additional investment of $90,000 (£18,500), which, it is believed, would more than cover the difference between the cost of the present type of boat and the one here presented.

Besides this saving in fuel there would be an additional economy in the matter of oil and general maintenance charges incidental to operating marine engines.

Super-Dreadnought New York Launched

The United States battleship *New York*, which is of the super-dreadnought type, was successfully launched Oct. 30 at the New York navy yard, Brooklyn, N. Y., in the presence of many distinguished guests, including the President of the United States, the Secretary of the Navy, the Governor of New York State and his staff, numerous officers of both the army and the navy, and many other persons prominent in the political and financial life of America. The launching weight of the hull was about 10,000 tons, and the vessel was released by a system of hydraulic triggers. The *New York*, like her sister ship, the *Texas*, which was launched May 18 by the Newport News Shipbuilding & Drydock Company, Newport News, Va., is 565 feet long on the waterline, 95 feet 2⅝ inches beam, extreme, 28 feet 6 inches mean draft, with a mean trial displacement of 27,000 tons and a full-load displacement of 28,367 tons. The vessel is designed for a speed of 21 knots, power being delivered to twin screws by two sets of triple-expansion reciprocating engines aggregating 28,100 indicated horsepower. Steam is furnished by fourteen Babcock & Wilcox watertube boilers, located in four separate boiler rooms. The total bunker capacity is 2,850 tons. The main battery consists of ten 14-inch, 45-caliber rifles, mounted in five twin turrets located on the center line of the ship. There are four 21-inch submerged torpedo tubes, twenty-one 5-inch rapid-fire guns, four 3-pounder saluting guns, two 1-pounder semi-automatic guns for boats, two 3-inch field pieces and two machine guns. The hull is heavily armored, the belt armor being 12 inches thick amidships. The turrets are protected by 14-inch armor. Tockolith, a special cement paint, is used to protect the under-water hull from deterioration.

LAUNCH OF THE UNITED STATES BATTLESHIP NEW YORK

Salvage Dock for Submarines

On March 11 a new salvage dock for submarines was delivered to the French Admiralty by her builders, the Ateliers & Chantiers de la Loire. She left St. Nazaire for Toulon, her home port, which is the home port of the Mediterranean French submarine fleet, and the place where many of these boats were built. The dock was towed to its destination by two powerful tugs, convoyed by a third steamer carrying the necessary supply of coal and provisions. The main dimensions of the dock are as follows:

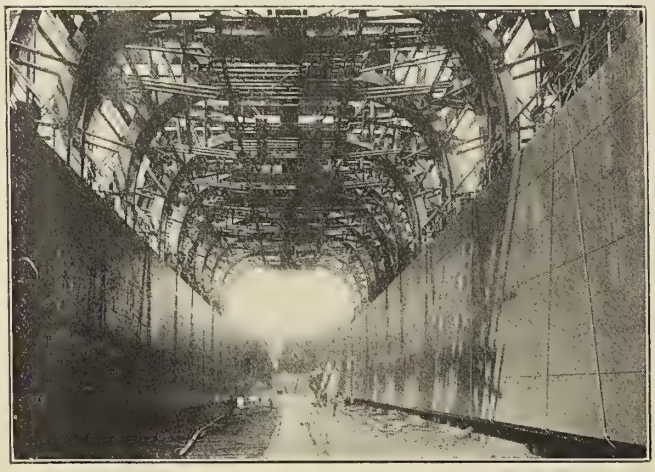
Length over all	322 feet 10 inches.
Main breadth	84 feet.
Breadth of each of the floating pontoons	20 feet 8 inches.
Depth	26 feet 3 inches.
Draft with coal and provisions	7 feet 8 inches.
Draft with a load of 1,000 tons	11 feet.
Displacement	2,300 tons.

The dock consists of two hulls or pontoons, joined together with ten steel frame girders, leaving a space 40 feet wide between the inside plating of the two hulls. Forward, these two pontoons are connected together, giving the bow the appearance of an ordinary tramp steamer. The two pontoons have been designed not only for maximum strength, but also for maximum stability, which is indispensable in salvage work. The starboard and port pontoons are exactly alike. The inside bulkheads are vertical plane surfaces, while the outside shell is built on the lines of a large lighter. The bottom is flat, and amidships the sides are nearly vertical, but towards the stem the lines become somewhat sharp, and at the stern they are very fine.

On each of the ten transverse girders are two tackles, one on the starboard side, the other on the port side, which are used for supporting the hull of the submarine. Each tackle is operated in connection with a hydraulic jack, which is used for making the strain uniform on all of the tackles, so that the tackles can be placed in operation either all at the same time or some of them independently. The power for this work is obtained from two electric generators having a total power of 150 kilowatts. Each tackle is tested individually for a load of 75 tons, making the total lifting power for the twenty tackles 1,500 tons. All that this apparatus is designed to lift, however, is 1,000 tons, so there is an ample factor of safety in the apparatus.

The power plant, which is located forward, consists of a Niclausse watertube boiler of 1,290 square feet heating surface.

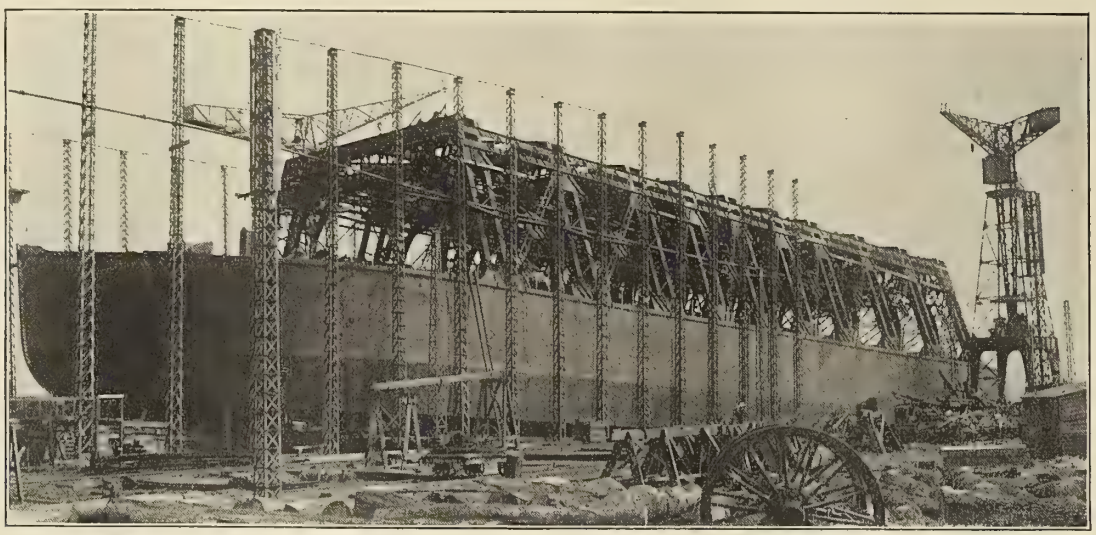
The two pontoons, as well as the forward part of the ship, are divided by numerous longitudinal and transverse watertight bulkheads. In the bottom there are water ballast tanks having a total capacity of 200 tons, which are used to obtain the best trim available under whatever circumstances may exist. There are accommodations for a crew of twenty in the forward part of the ship.



SALVAGE DOCK—FROM STERN LOOKING FORWARD

As compared with the German submarine salvage ship, the *Vulcan*, the new French salvage dock has no self-propelling machinery. It is reported that the German ship is able to steam at a speed of 12 knots under favorable conditions of weather. On the other hand, in bad weather the French dock will be difficult to maneuver, and since, as a rule, submarines get into trouble on the coasts, it is expected that this dock will have some difficulty in working in such surroundings, under the control of tugs, unless the weather conditions are ideal.

Owing to the fact that the French dock has a very small draft, even with a load of 1,000 tons, she can be used successfully in shallow water, which is important for the salvage of submarines. The machinery on this dock was built in the Nantes Works and the hull in the St. Nazaire yard.



FRENCH SALVAGE BOAT FOR SUBMARINES

McAndrew's Floating School

BY CAPTAIN C. A. McALLISTER*

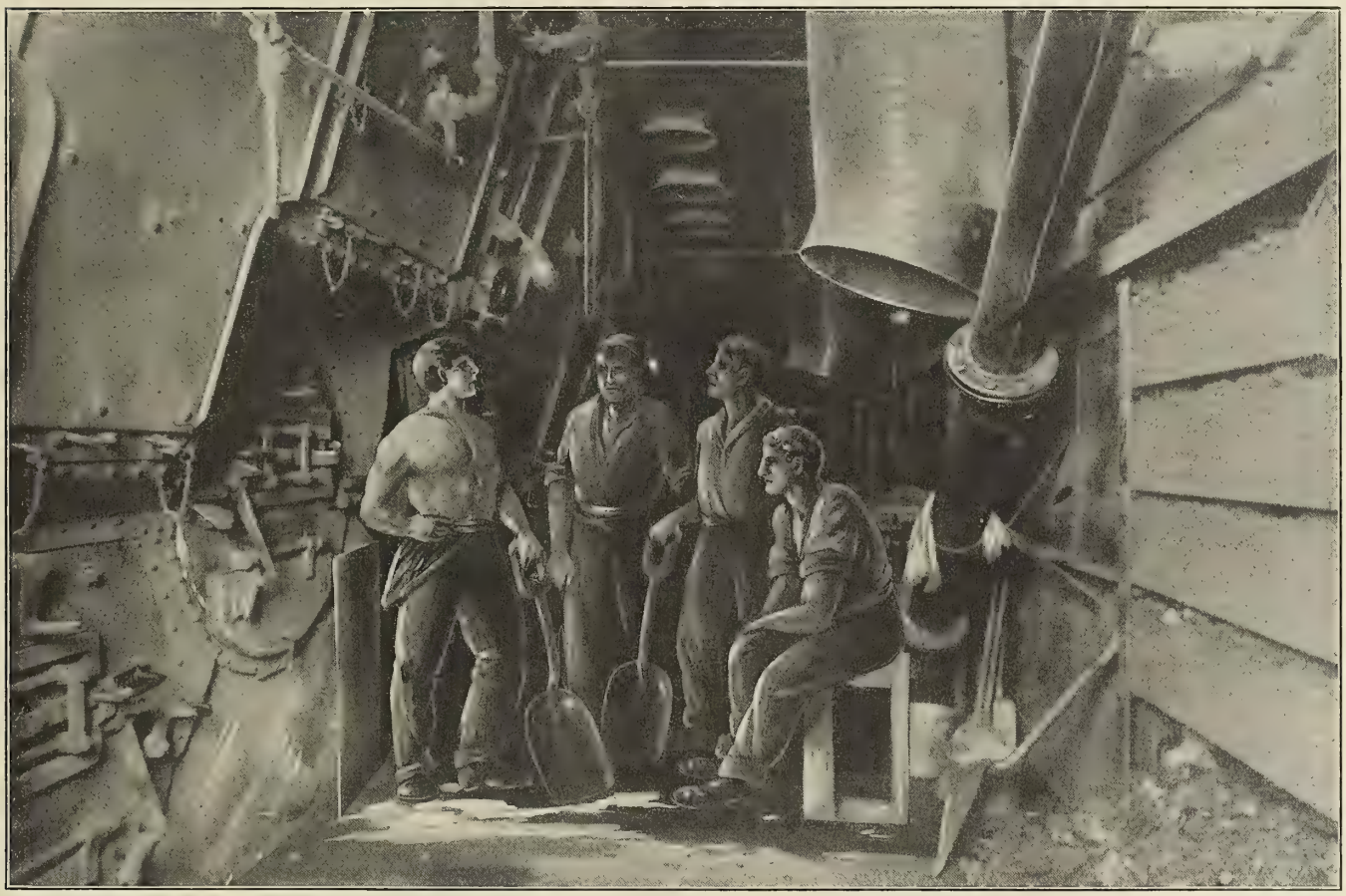
CHAPTER I

Introducing James Donald McAndrew

"I'm tired of shoveling coal and being bossed around," remarked Tom O'Rourke, one of a party of four husky young fellows who, at the end of a voyage, were just banking the fires in the stokehold on board the coasting steamer *Tuscarora,* then lying at her pier on the East River. This remark brought about a general laugh from the other members of the party. "Well," replied Jim Pierce, after the laugh had subsided, "what are you going to do about it? That's just what I've been thinking pretty strongly about; here I've been three years on this packet, working like a dog, and I don't see any chance of my ever getting anything better to do; of course, after a while, I may get a chance to squirt oil on that old mill of ours, but what I want to do is to get a 'ticket' and boss the job myself."

"Well, why don't you," rejoined Henry Nelson, another member of the party. "The Chief told me the other day that he had worked himself up from the bunkers, and he's pretty good at figures, too. If we only had the head on us that he has, we needn't wait long before the steamboat inspectors would pass us out the right kind of a paper."

Gus Schmidt, the fourth member of the party, had, during all this conversation, stood by quietly, drawing great puffs of smoke out of his five-cent meerschaum, and taking in everything that was said. As became his German ancestry, he was stolid of disposition and not given to saying much unless he had something to say. Finally, after he thought it was his turn to get into the conversation, he said: "You fellows make me tired with all your pipe dreams; why don't you get down to business; now I'll tell you what let's do. I just heard the 'Super' on the dock say to-day that the bunch of kettles in this ship are to come out, that we are going around to Philadelphia to get some new ones, and the ship is to be given a general overhauling at the same time, so as to put her in good shape for the next season's work. The Chief is going to boss the repairs, and the four of us are going to be kept by to chip and paint the coal bunkers and do some other high-class stunts like that. The whole job will last about six months, and as we won't have anything particular to do at night, let's buy some books and get the 'old man' to play school teacher for us."



"LET'S BUY SOME BOOKS AND GET THE 'OLD MAN' TO PLAY SCHOOL TEACHER FOR US"

"Fine business, Dutchy," said O'Rourke; "you've got a head on you like a clock. We'll go to it." The idea also met the approval of the other two, and it was decided to brace the genial Chief with the proposition.

James Donald McAndrew was a young man, not of French descent, as you no doubt may have surmised by this time, who was born on the great East Side in New York some thirty-eight years ago. Educated in the public schools until he was fourteen, he had successfully served an apprenticeship in a

* Engineer-in-Chief, U. S. Revenue Cutter Service.

big general repair shop on the waterfront, and at the same time had gone to night school at Cooper Union, where, being naturally bright, he had become thoroughly grounded in the rudiments of an engineering education. Being fond of the water, he had shipped on board a twenty-five hundred ton steamer as a fireman, and in a very short time had taken out his license as a Third Assistant. Being naturally a hustler and capable of making friends among his superior officers, he found himself at the age of thirty-eight the Chief Engineer on the *Tuscarora,* the biggest ship of the line. It was therefore quite in keeping that the Superintendent should have selected him as inspector of the extensive repairs the ship was about to undergo. Unlike many young men of his age who lead a seafaring existence, he took life somewhat seriously and had gone through the trying years of his development without falling into any bad habits. His father had died when the young man had just started in as a Third Assistant, which left upon him the responsibility of looking after his widowed mother and two young sisters. Consequently he was not given to wasting his money and could be found generally attending strictly to his business instead of roaming around town at nights when the ship was in port. His kindly disposition, ready wit and general all-around ability had won for him the respect of the crew, so he was not at all surprised this particular evening upon opening his stateroom door in response to a knock to find four members of the fireroom gang, hats in their hands, standing on the outside. "Well, boys, what can I do for you?" was his cheerful salutation.

O'Rourke, the self-constituted spokesman of the party, blurted out: "You see, Chief, it's this way; us four youngsters have an idea that we would like to get ahead in the world, and there don't seem to be much of a show for us if we don't get something in our heads. Dutchy Schmidt here thinks that if we will get some books, you might help us out when we get around to Philadelphia this winter putting in the new boilers. We'll have every night in, and as we will all live on the ship, we thought as how you might teach us something for an hour or so every night. We'll make it all right with you for the time you give us. What we want is to be able to get out our 'tickets' from the steamboat inspectors, and we know that you can give us the right steer."

"So you want to make me a school teacher, eh?" laughingly rejoined McAndrew. "That isn't a bad idea, though, and if you fellows mean business and will get right down to brass tacks I might consider it. I want to tell you one thing right now, and that is if I do undertake such a job I don't want any monkey business. You'll have to study hard or you'll find me worse than any old Yankee schoolmaster you ever dreamed of. Before I sign up on this proposition I want to know something about each of you. Of course I know you are all pretty good firemen and 'tend to business, but what I must find out from each of you is something about how much of an education you have. I know you are not graduates of a high school or you wouldn't be here flirting with a slice-bar and wrestling with clinkers for a living. O'Rourke, let's hear your spiel first."

"Well, sir," replied that worthy, "I ain't much on book learning, but I can write pretty well, understand arithmetic, have studied geography and know a little something about history. When I was a boy I used to know the Catechism from one end to the other, but I'm a little shy on that now."

"Never mind," said McAndrew, "this will be no Sunday school you are going to tackle. How about you, Nelson?"

That descendant of some Norse king gave an outline of his educational career which closely corresponded with O'Rourke's, excepting the Sunday school part. Schmidt and Pierce followed in about the same strain, so that the upshot of it all was that Mr. McAndrew considered his contemplated class was on a par so far as their proposition was concerned.

"I can see right now that I am up against a hard proposition to train you fellows up so as to enable you to take out your papers, but as long as you mean business I am willing to try out your scheme," said the Chief.

"Thank you, sir," was the chorused reply from all four, as light-heartedly they took their departure. Had they been college boys one of them would probably have yelled out, "What's the matter with McAndrew?" to be self-answered in a raucous yell, "He's all right," etc., but they had not yet reached that high degree of culture.

CHAPTER II

School Opens

About two weeks later the *Tuscarora* steamed up the Delaware River to the shipyard where the repairs were to be made, fires were hauled, most of the crew discharged and preparations made to begin the work. The four young firemen and Mr. McAndrew were kept very busy for a time after the arrival of the ship, but it was finally decided that the school should begin on what happened to be the first Monday night of the month. The youngsters in the meantime had rigged up a pretty fair school room in the engineer's storeroom, and had hung up a good-sized blackboard on one of the bulkheads. No testimony was given as to just where they obtained this blackboard, but it is safe to say that the shipyard people must have contributed involuntarily from their pattern and paint shops toward the cause of education.

Monday night, shortly after supper, the first session of the McAndrew School commenced without any frills or formalities. There was no necessity for a roll-call, as a full attendance was in evidence. O'Rourke, Pierce, Nelson and Schmidt had each indulged in a clean shave for the momentous occasion, and McAndrew himself appeared a little more perked up than usual in honor of his debut as a teacher.

Assuming a demeanor somewhat in keeping with his new responsibilities, McAndrew addressed his class as follows: "Young men, we are about to start in our course of training. I don't propose to turn out a lot of high-brows from this floating school, but what I do intend, if possible, is to drive enough theory, or whatever you call it, into you to enable you with practical experience to pass your examinations for a license as assistant engineer before any board you happen to go against. I have been making inquiries to find out just what branches you ought to be drilled on to pass the examination, and I find that the law actually requires only two subjects, and that is how to make calculations concerning a lever safety-valve and how to figure out the staying of the flat surfaces of a boiler. Of course, no man can be an engineer who understands only those problems, and you will find that before you ever get your 'ticket' you will have to get a good general idea of the whole subject, as these local boards are very thorough. These examinations won't be like the old stories they tell about the examinations held in the early days of the civil service, for example, of how a candidate for a job in the Custom House was asked, 'How many Hessians came over here during the Revolutionary War?' Not knowing definitely, he answered, 'A d——n sight more than went back,' and, as the story goes, he got the job. Another one was the candidate for the position of letter carrier, who, when asked, 'How many miles from the earth to the moon?' replied, 'If I have to deliver letters there I don't want the job.'"

"You will find that the questions which the steamboat inspectors ask you to answer will be only such as you must know to make successful marine engineers."

"I therefore propose to post you in a general way on the principal things a seagoing engineer ought to know. I take it for granted that all of you know enough about arithmetic to make ordinary calculations, so we will not waste any time in going over that subject, as you will get enough practice in it as we go along on the other subjects."

"At the start, I will insist on each of you getting a thorough understanding of a few of the elementary definitions in what is known as mechanics, as no one connected in any way with engineering in any of its branches can make a success of it unless he does understand these underlying facts."

(To be continued.)

British Battle Cruiser Princess Royal

BY F. C. COLEMAN

The British battle-cruiser, *Princess Royal,* constructed and completely equipped for service by Messrs. Vickers, Limited, of the Naval Construction Works, Barrow-in-Furness, has established a new world's record for vessels of her class. She is 660 feet long between perpendiculars, 88 feet 6 inches beam, and, with a draft of 28 feet, has a displacement tonnage of 26,350 tons. Like H. M. S. *Lion,* she is the largest cruiser yet built for the British navy, and is also the broadest, excelling even the *Lusitania* and the *Mauretania.*

The eight 13.5-inch guns in the *Princess Royal,* as in the *Lion,* are much more effectively disposed than in the earlier armored cruisers. Forward, there are in the center line two twin-gun turrets, the one to the rear being at a higher elevation, so that its guns fire over the turret in front. Amidships, on the center line, there is one twin-gun turret and aft there is another. Thus all eight guns fire on either broadside and four fire directly ahead, but by giving a slight angle of helm the ship may alter her course sufficiently to enable all eight guns to be utilized in chasing the enemy.

In the *Conqueror,* which belongs to the *Orion* class, there are ten 12-inch guns, arranged two pairs forward and two pairs aft, the rear pair in each case being at a higher level than those immediately in front. The remaining turret is on the center line amidships. There are in both the *Princess Royal* and the *Conqueror* sixteen 4-inch breechloading guns for repelling torpedo boat attack; these are located on the superstructure deck.

In the matter of armor protection something had necessarily to be forfeited in the case of the *Princess Royal,* in order to ensure the exceptionally high speed required by the tactician. This is, perhaps, the only point, with the exception of the omission of two of the primary guns, which differentiates the two types—the battleship and the armored cruiser. As in all British warships, there are three tiers or strakes of armor plating. While the thickness of the waterline strake in a battleship is 12 inches, the remainder up to the upper deck being 9 inches or 8 inches, the *Lion* has, for the waterline and for the strakes above it, 9 inches of armor. The gun positions are also well protected. Forward and aft the thickness of the broadside armor is reduced by gradual stages to 4 inches. It will thus be seen that the *Princess Royal,* notwithstanding her exceptionally high speed, has armor which is superior in its resistance to perforation by modern guns to that of pre-dreadnoughts, so that these latter ships would make a very poor show unless they came within 9,000 yards range, when the guns of the *Princess Royal* would be enormously more destructive than the 12-inch guns of the pre-dreadnoughts. In fact, with their legend speed of 28 knots, as compared with the 17 and 18 knots of the earlier ships, the *Lion* and the *Princess Royal,* as well as the *Queen Mary,* now being built by Messrs. Palmer, at Jarrow-on-Tyne, could steam round a fleet of pre-dreadnought ships and fire when it suited them, keeping beyond the range which would enable the old battleship guns to penetrate the armor of the modern cruiser.

It is often said, of course, that personnel must necessarily be considered, but it is reasonable to assume that the efficiency would be of as high a standard in the new ships as in the old, especially as in the former there is superior gun-control and sighting mechanism, which will insure greater accuracy in service.

The principal steam trials included a 24-hours' run at two-thirds the total power, and an 8-hours' run at full power. Both tests were, of course, carried out at the service draft and under limiting conditions as to air-pressure in the stokehold. The coal consumption on the 24-hours' trial was 1.16 pound per shaft horsepower per hour for all purposes. The power on the 8-hours' run exceeded that required by the contract, and the speed was also considerably in excess of the designed rate, notwithstanding that no attempt was made on the official trial to test the maximum steaming capacity of the boilers. The usual maneuvering and astern trials were also carried out, and one day was devoted to the test of torpedoes and the gun-mountings, which were also supplied by the Vickers Company. The ordnance trials were carried out in record time, due to the precision with which the gun machinery responded to the requirements of the test.

The *Princess Royal* and the *Lion,* being alike both in respect to the form of hull and the propelling machinery, the British Admiralty ordered at the outset two sets of propellers for the *Lion* and two sets for the *Princess Royal.* The *Lion* carried out duplicate tests with the respective propellers, and the second set was fitted to the *Princess Royal* and she carried out the measured-mile trials, corresponding exactly to those run by the *Lion* with the different sets of propellers. The results of all four sets of trials will enable the Admiralty to determine the most suitable dimensions of screw propellers for this type of ship, and these will be utilized in both vessels.

Upon her full-power trials, off Plymouth, the *Princess Royal* attained the high speed for a vessel of her class of 32 knots. But that was not the best she could do. On her return she was drydocked at Devonport and her propellers were changed. She coaled and went out again for six runs at three-fourths and then at full power on the Polperro measured mile. On the last-mentioned occasion it is authoritatively reported that she reached a speed of no less than 34.7 knots, and made an average of 33 knots, which establishes a world's record for vessels of her class. It may be recalled that the original maximum speed of the *Lion* was 29 knots, but that she subsequently made 31.7 knots. The *Princess Royal* was launched at Barrow in April, 1911, and was designed for an official speed of 28 knots, but with the full anticipation that she would do more.

New Hamburg-American Liners.—The Hamburg-American Line recently received from Messrs, Swan, Hunter & Wigham Richardson, of Wallsend, the handsome new liner *Karl Schurz.* On Oct. 25 the same builders successfully launched an exactly similar ship, the *Emil Boas,* named after the late chief representative of the Hamburg-American Line in New York, who died recently. The construction of the ship has been under the superintendence of the owners' resident inspectors, Mr. Claus Hatje and Mr. J. Drieling. The chief dimensions of the ship are 425 feet long over all, 51 feet beam and 33 feet depth. The deadweight carrying capacity will be about 6,100 tons. The twin-screw engines, and also the boilers, are being built by the Wallsend Slipway & Engineering Company. The ship is designed to carry 70 first class passengers and also cargoes of fruit. Electric lighting will be installed and also apparatus for receiving and transmitting radiograms. Messrs. J. & E. Hall, Ltd., of Dartford, are supplying the refrigerating machinery. Messrs. Robson & Sons, of Newcastle-on-Tyne, have in hand the upholstery and the furniture, all of which will be most handsome and comfortable. The music room, dining saloon and smoke room will be luxurious apartments. Special attention is being given to the free ventilation of all parts of the ship. The staterooms for passengers will be unusually lofty and most comfortably furnished.

Note on the Strength of Watertight Bulkheads

BY A. J. MURRAY

It must be the sincere wish of everyone at all interested in the strength of ships that the recently appointed commission in Great Britain will carry their investigations to a point which will, once for all, eliminate the uncertainty which now exists regarding the strength of watertight bulkheads.

Without venturing to criticise the structural strength, or weakness, of the main bulkheads of the *Titanic,* there is much reason to believe that the great majority of bulkheads, as at present constructed, have not sufficient reserve strength. The frame of mind of the designer should be such that he contemplates as a certainty, rather than as a remote possibility, the bilging and laying open to the sea of the compartments of the vessel. Instead of allowing for 15 or 17 tons maximum fiber stress with permanent set under test, the maximum allowable stress under the worst possible conditions should be much less and with practically no permanent set.

Since the 1890 British Board of Trade Committee made their report, much light has been thrown upon the subject by investigators both in England and in America, and the problem has been brought, not to a conclusion, but to a point where judicious and copious experiments can be made with great effect. Practically all watertight bulkheads of modern vessels consist of steel plates, stiffened by vertical bars bracketed to the upper and lower abutments. Present-day investigators seem unanimous in considering that the whole of the water pressure on a bulkhead should be regarded as taken by the stiffeners alone, the tarpaulin or stretching resistance being but a factor and an undependable factor on the credit side. It is now customary to test the more important bulkheads of a vessel by filling a compartment on one side with water at a specified head, and the only experimental data extant are the deflection, permanent set and general behavior of bulkheads under such tests.

Adopting the usual method of regarding the stiffeners and the narrow strip of bulkhead plating in their vicinity as girders, we come at once to one of the difficulties which experiment alone can overcome.

We require to know:

1. How broad a strip of the bulkhead plating can be taken to act with the stiffener and form a covering plate of same.

2. In treating the girder as a beam what span should be taken?

3. To what extent do the end brackets constrain the stiffener under load.

4. What proportion of the deflection under test is due to elastic bending, apart from the residual deflection due to creep of the riveted attachments and shear.

The most thorough experiments yet made to determine the relation between calculated and actual deflection of girders are those described by Dr. Bruhn in the Transactions of the Institution of Naval Architects for 1905. Dr. Bruhn used a 12-inch covering plate for his girders. Mr. Norton, in his investigations of the strength of watertight bulkheads, assumed a breadth equal to three times the bulkhead flange of the stiffener, and more recently Capt. Hovgaard a breadth about one and a half times that of the bulkhead flange.

To see what difference the breadth of the covering plate makes in the resultant stiffness, take the case of a 10-inch by 3⅜-inch by 3⅜-inch by 21.7-pound channel stiffener riveted to a 12-pound bulkhead: With no cover plate the modulus is 18.3, with a 3⅜-inch cover plate the modulus is 22.2, with a 6-inch cover plate the modulus is 25.7, with a 12-inch cover plate the modulus is 33.5, and with a 30-inch cover plate the modulus is 55.5, so that with a 12-inch cover plate the fiber stress for the same bending moment is 50 percent less than with a 3⅜-inch cover plate.

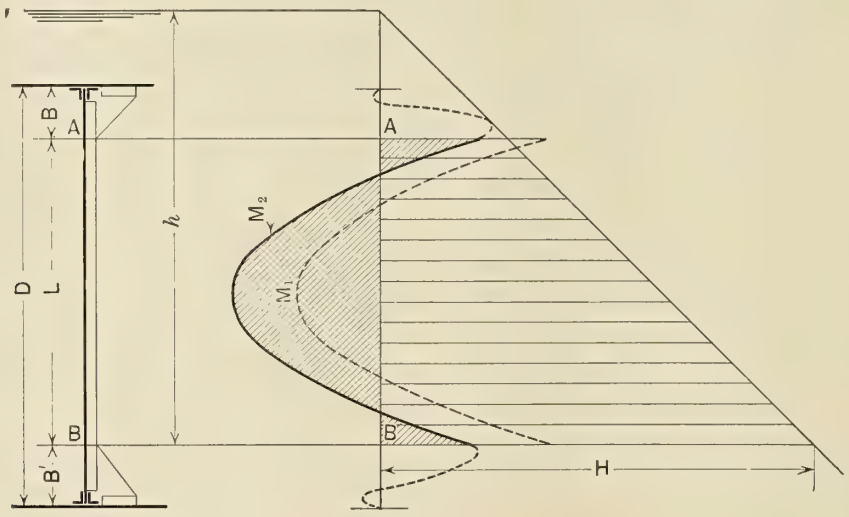


FIG. 1 FIG. 2

Only by careful experiment can this crucial question be answered. The method of experiment should be to bend a set of individual stiffeners under known conditions (say free ended) and then to bend the same or a similar set when riveted up to plates. By comparison of the deflections we should determine how much of the plating should be regarded as working with and supporting the stiffeners.

Again, the exact usefulness of the brackets at top and bottom of the stiffeners can only be determined by experiments carried out for different classes of bulkheads and the careful analysis of the tests already made. The reactions and stresses to which stiffener brackets are subject have been treated with great skill, but however useful these investigations with regard to the design of the brackets themselves, they do not furnish

a reliable starting point when considering the whole bulkhead. The question of the strength of the bracket attachments involves the further question of what length of the stiffener should be considered as the girder span when applying the ordinary beam formulæ to obtain the elastic deflection. Some investigators take the span as the full length of the bulkhead stiffener, some as the inside distance between the brackets, while others, again, take some intermediate length.

Briefly the investigator appears to proceed thus:

1. Decides whether he will assume the stiffener girder as free or *encastre*.

2. Having adopted one of these points of view, chooses a girder span and breadth of bulkhead strip, which will make his calculated deflection agree with that observed under test.

3. Makes some calculation as to the behavior of the brackets, so as to justify the span chosen.

When such an investigation is confined to a particular class of bulkhead, an empirical law can be obtained giving fairly good results. But such a method lacks generality.

The method we strongly recommend is similar to that used when analyzing a series of bulkhead tests, the result of which investigation were published in 1909.*

Consider the ordinary case of a bulkhead having vertical stiffeners bracketed at top and bottom. Fig. 1 shows in section a stiffener element of such a bulkhead:

D = depth of bulkhead.

L = inside distance between brackets.

h = head of test water above the bottom of bulkhead.

Between the inside terminals of the brackets—*i. e.*, between A and B in Fig. 1—we have a girder subject to a given pressure load, indicated by the hatched area in Fig. 2. If, now, we know what the bending moments at A and B are, then all the stresses for the girder $A\,B$ are known, and this quite independently of what the bending moments are above and below the points A and B, which latter bending moments depend on the type of bracket used.

Suppose M_1 (Fig. 2) is the curve of bending moments from A to B on the supposition that the brackets absolutely fix the girder at A and B. Then the actual bending moments are represented by some such curve as M_2. The actual bending moments at A and B are thus less than those given by curve M, and this ratio we term the degree of constraint. Knowing, then, this degree of constraint, we are able to determine definitely all the stresses on the stiffener girder $A\,B$.

Experiment alone can determine the degree of constraint. For the series of tests analyzed, it was found that the bending moments at the girder ends were about half that calculated on the assumption of absolute fixidity—i. e., about 50 percent constraint. The method used was that of comparing the calculated and observed deflections, but when publishing the results, no exact expression was given for calculating the deflection.

Referring to Fig. 1, the head of water above the bottom of the girder $A\,B$ is $D - B^1 = H$, and putting

$$\frac{\text{head}}{\text{span}} = \frac{H}{L} = \alpha,$$

the perfectly general formula on the assumption of fixed ends

for the bending moment at A is $\frac{L^2}{12}(\alpha - 0.6)\,W$,

and at B is $\frac{L^2}{12}(\alpha - 0.4)\,W$,

where $W = b + 0.279$.

b = breadth of plating strip in inches.

L = span in feet.

Test water taken at 62.5 pounds per cubic foot.

As, however, the constraint is not absolute at A and B, the end bending moments are only a fraction of these.

Suppose β is this fraction (or degree of constraint), then the bending equation for the girder $A\,B$, reckoning from the lower end, is

$$M_x = EI\frac{d^2y}{dx^2} = R_b\,x - \frac{W\,\alpha\,Lx^2}{2} + \frac{x^3}{6}W + \beta\,M_b - \frac{x}{2L}\beta\,(M_b - M_a)$$

where R_b is the reaction at B on the supposition of free ends.

Integrating out we obtain

$$\Delta = (30\,\alpha - 15 - 24\,\alpha\,\beta + 12\,\beta)\frac{W\,L^5}{64\,E\,I} \qquad (1)$$

where Δ is the deflection at the middle of the girder $A\,B$.

For fixed ends $\beta = 1$,

$$\text{giving } \Delta = \frac{3\,L^5}{8\,E\,I}(\alpha - \tfrac{1}{2})\,W.$$

For free ends $\beta = 0$,

$$\text{giving } \Delta = \frac{15\,L^5}{8\,E\,I}(\alpha - \tfrac{1}{2})\,W.$$

Comparing the observed deflections under test with the theoretical deflection given by equation (1) we obtain the value of the constraint β, and thus know the stresses at every point of the girder. Before making this comparison, it will, however, be necessary to bear in mind that the observed deflection is, in fact,

bending deflection + residual deflection.

A glance at the results of Dr. Bruhn indicates that for such a stiffener as that quoted above, with a 12-inch cover plate, we should have

Residual deflection equals: Span of 10 depths, 60 percent bending deflection; span of 14 depths, 50 percent bending deflection; span of 50 depths, no bending deflection.

The observed deflection will thus require to be modified according to the depth and type of stiffener.

The residual deflection as taken here contains the shear deflection, which could be calculated separately and will be found to be a considerable proportion of the whole for short stiffeners having thin webs.

For the form of stiffener quoted the approximate relation is expressed thus:

$$\frac{\text{Shear deflection}}{\text{Bending deflection}} = \frac{15\,A\,f}{A\,w}\left(\frac{h}{L}\right)^2$$

where $A\,f$ = area of flanges.

$A\,w$ = area of web.

h = depth of girder.

L = span of girder.

It will probably be found more practical to determine the total residual deflection per unit length of stiffener for different forms of section.

In conclusion, this general method lends itself to standardization.

Thus, instead of using Δ we can use

$$\frac{\Delta\,64\,E\,I}{W\,L^5} = d.$$

Then, no matter what the dimensions of the bulkhead, "d" would be the same degree of constraint "β" and same head ratio "α."

* Proceedings of the Northeast Coast Institution of Engineers and Shipbuilders.

The Twentieth Annual Meeting of the Society of Naval Architects and Marine Engineers

The twentieth annual meeting of the Society of Naval Architects and Marine Engineers was held at the Engineering Societies' building, New York, Nov. 21 and 22. Morning and afternoon sessions were held each day, and the meeting closed with a banquet at the Waldorf-Astoria on the evening of the 22d. The meeting was opened with an address by Stevenson Taylor, president of the society. Following this the report of the secretary and treasurer was read, showing a membership of 785, as compared with 733 last year. The financial statement showed a balance of $18,000 (£3,700), as against $8,000 (£1,640) last year. Col. Robert M. Thompson, of New York, was unanimously elected president for three years, beginning Jan. 1, 1913, and D. H. Cox was re-elected secretary and treasurer. It was voted that the society participate in the Panama-Pacific Exposition in San Francisco in 1915, and that the sum of $2,000 (£410) be raised for this purpose. Fourteen papers were read and discussed during the meeting, abstracts of which follow:

No. 1—Experiments on the Fulton and the Froude

BY PROFESSOR C. H. PEABODY

(This paper will be published in the January number.)

No. 2—The Design and New Construction Division of the Bureau of Construction and Repair of the Navy Department

BY NAVAL CONSTRUCTOR R. H. ROBINSON, U. S. N.

ABSTRACT

This article deals only with the methods of handling an organization engaged in design and in passing on matters of new construction, leaving the work produced to speak for itself. The Division of the Bureau of Construction and Repair produces in general:

(*a*) Estimates for new construction.

(*b*) Preliminary designs for ships, including plans and calculations.

(*c*) Contract designs for ships, including plans, calculations and specifications.

(*d*) Action on contractors' plans and on specifications for auxiliaries submitted by builders.

(*e*) Standard plans and miscellaneous design work.

Incidental to each of these are many duties, some of which are handling the reports of boards on changes on ships, the compilation and tabulation of data for use in one of the main duties mentioned above, preparation of allowance lists, design and record of issue of small boats, preparation of annual report and ships' data books, etc. A definite section also handles the question of reports of the trial board, takes action on the more important alterations to ships in service, etc.

The endeavor is to produce the greatest amount of work possible with a minimum effort and in a minimum of time.

With the object of saving time, a complete study has been made, and a number of what the writers consider the most important features of modern shop methods have been adopted, particularly in routing, assigning and planning work, making provision for consultation with responsible officers without delay, etc.

The division is divided into five parts:

1. The "office."
2. The electric branch.
3. The criticism branch.
4. The design and scientific branch.
5. The blue-print room.

No. 4 is further divided into two parts—the design room and the scientific and computing room—but both work directly together and directly adjoin. The design room also includes the specification desk.

The Office.—In the office is desk space for four officers, the writer and three assistants. Frequently one of the officers must be absent on other duties, but one of the officers, the senior assistant present, is always at the desk to handle papers, answer the telephone and keep in touch with all ends. Another assistant spends practically his entire day in the criticism branch, going from desk to desk, giving instructions, answering questions, etc. The third assistant is at present developing a special line of work, which also keeps him in the criticism branch. Eventually it is hoped that it will work out that there will be an officer continually in each of the design and criticism branches. The head of the division spends about one-quarter of his time at his desk, and the balance with the chief constructor, in the drawing offices, mostly in the design and scientific branch, or in expediting inter-bureau work about the department. It is the writer's duty as the head of the division to keep the chief constructor informed of the work of the division and to keep advised of his wishes as to the details of the work.

The Electric Branch.—The electric branch, which immediately adjoins the office, is directly controlled by the officer at the desk. It includes the Bureau's electrical aide and the assistant electrical aide. Its work consists of preparation of and action on electrical specifications and plans, passing on electrical test reports, design of electrical auxiliaries, keeping track of electrical subordinates outside the Bureau, and, in general, all electrical questions before the Bureau. Special investigations of new electrical applications for the Bureau's work on board ship are made in or directed from this branch.

The Criticism Branch.—This branch examines and criticises: (*a*) Plans produced in design branch before issue; (*b*) plans and specifications submitted by builders in developing the details. It employs a chief draftsman, his assistants and fifteen draftsmen with stenographers and plan clerks. This branch is organized on the functional system, each employee or group of employees handling a specialty or kindred specialties. The specialties covered are considerable in number, and are divided generally as follows, with one or more employees to each sub-division:

Changes; allowance lists and small boats; plans, their filing, correction and distribution to navy yards; joiner work and general arrangement; repairs and alterations of ships in the fleet, trial reports, etc.; structural work; auxiliary machinery and mechanical details; ventilation, drainage and piping systems; turrets, gun emplacements and armor; submarine boats; miscellaneous.

In this room are kept only the plans of ships building and one or two classes back (those most constantly referred to). The balance—a very large number—are kept in fireproof vaults at the Washington navy yard.

The Scientific and Design Branch.—This branch produces the plans, specifications and calculations for new ships of the navy. It is under the direction of a leading draftsman with another leading draftsman directly in charge of the design plan room itself. The design plan room contains ten draftsmen, eight of whom make and trace the plans and two prepare the specifications, filling what is called the specifications desk.

Scientific and Computing Room.—The scientific and computing room contains thirteen draftsmen at the boards engaged on all kinds of scientific investigations, calculations and computations as to ships.

The Blue-Print Room.—This is in two parts—one in the Bureau and the other at the navy yard, increased facilities being needed to take care of all the blue-prints required by the Bureau.

Method of Work.—The products of the division enumerated above nearly always result from the receipt of a letter. The paper explains in detail the method of routing and assigning such letters to the different departments, giving instructions, supplying materials, obtaining the proper action and recording progress, together with mention of the numerous schemes devised to increase the efficiency of the work.

The system outlined above is a development of many years of experience in this character of work, and the writer claims no special credit for it. The fundamentals of the organization were determined under a former president of this society when he ably held the position of chief constructor of the navy. The development has gone on under the writer's immediate direction during the incumbency of Chief Constructor Capps and his successor, the present Chief of Bureau, Chief Constructor Watt. The credit, if any, is due as much to the individual employees as to any one, as through their suggestions many, if not most, of the improvements have been made.

No. 3—Engineering Progress in the U. S. Navy

BY CAPTAIN G. W. DYSON, U. S. N.

(This paper is published on page 490.)

No. 4—Marine Lighting Equipment of the Panama Canal

BY JAMES PATTISON

ABSTRACT

In accordance with the plans of the eminent army engineers who are carrying the work to completion, the Panama Canal will be lighted throughout by automatic unattended lights, each having a distinctive characteristic. At the entrances and through Gatun Lake a double row of about sixty automatic acetylene-lighted buoys will mark the channel. The channel will be further defined by powerful, rapid-flashing range lights, one set at either end of each successive tangent, thus permitting vessels going in either direction to take their range over the bow. The center lines of each range are set apart sufficiently to enable the largest vessels to pass one another in safety. Through the Culebra cut, or wherever the proximity of the banks permits, beacons will be used instead of buoys.

The Panama buoys consist of a cylindrical body or chamber, 8 feet in diameter, made of 5/16-inch steel plate with dished heads riveted on. Through the center of the body passes a tube, to which is bolted a counterweight. A pyramidal skeleton tower is bolted to cast steel foot brackets, and carries the lantern at a focal height of 15 feet. The draft of the buoy is 12 feet, and the total weight without anchor chain 10,500 pounds. Before painting and shipping the buoy is subjected to a hydrostatic test of 15 pounds per square inch. With reference to the gas supply and lighting apparatus, there are four accumulators, filled with dissolved acetylene and inserted in pockets, furnished with hinged covers for facilitating the removal and renewal of the accumulators. The lantern contains the pressure regulator or governor and the flashing mechanism. The high-pressure gas is led from the accumulators to a manifold, thence up a leg of the tower and through a shut-off valve to the governor.

The system of storing acetylene in portable accumulators is known as Dissolved Acetylene (D. A.), and is based upon the properties of acetone in combination with a suitable porous substance. The type of accumulator used on the Panama buoys is tested to 75 atmospheres, and completely filled with the porous mass, a solid material possessing a porosity of 80 percent. That is to say, although the cylinder is apparently filled quite full, only 20 percent of the pace is really occupied by the solid body, the remaining 80 percent being available for holding the liquid. Half of this remaining space is occupied by acetone, which soaks into every pore of the porous substance; the other half, or 40 percent of the original volume of the cylinder, is thus available for the expansion of the liquid. The cylinder is closed by a reliable valve, through which the gas is pumped into the accumulator, and through which it flows out again when required for service.

As the acetone charge is equal to 40 percent of the original volume of the cylinder, and the solvent capacity of acetone is twenty-five times its own volume per atmosphere of pressure, the acetylene storing capacity of the accumulator is, accordingly, ten times its own volume for each atmosphere. Therefore, at a pressure of 10 atmospheres an accumulator contains 100 times its own volume of acetylene; at 12 atmospheres 120 times, and so on, this being computed for a temperature of 15 degrees C. (59 degrees F.).

A notable feature of dissolved acetylene is that its usefulness is independent of the temperature. It should, however, be observed that changes of temperature, although in no way interfering with the usefulness of the gas accumulator, cause corresponding changes of pressure inside the accumulator. These variations of the pressure will only slightly affect the gas quantity at disposal; however, every atmosphere's pressure indicated by the pressure gage does not, at all degrees of temperature, represent the same quantity of gas at disposal. As the porous substance is not a very good conductor of heat, only a prolonged change in the temperature will materially affect the temperature in the interior of the accumulator. Replenishing of the acetone at intervals, together with occasional painting, is the only item of up-keep connected with the gas accumulators.

From the foregoing it will be seen that acetylene is stored in the accumulators under varying degrees of moderately high pressure. At the burner, however, a constant low-pressure is required; therefore the gas must be passed through a pressure regulator or governor to reduce the high-pressure to the required low constant pressure. By this means, irrespective of the gas pressure in the accumulator, whether high or low, and of the gas consumption, whether large or small, the gas always issues from the governor at the constant low-pressure suitable for the burner

An entirely new principle in flashers permits the production of as many as 55,000 separate and distinct flashes from 1 cubic foot of acetylene. The new flasher may be adjusted to give light periods of any desired length of time down to one-tenth of a second, or less, alternating with dark intervals of any desired length. Single, double or triple flashes, etc., can be produced with ease; in fact, any light character obtainable in lighthouses equipped with the most modern lens arrangements can be produced by the new flasher. For lighting the gas as it flows out of the burner during the light periods, a special pilot burner is used.

It is naturally of the utmost importance for the safety of navigation that the light character, *i. e.*, the ratio between light and eclipse, after having once been fixed must not vary in the slightest degree. Of the light characters adopted by the army engineers for the lights on the Panama Canal, the flashes do not in any instance exceed two seconds' duration, and the majority will be set to .3 of a second.

The Panama Canal buoys will all be equipped with sixth order lanterns. With a 1-foot burner of 46 Hefner candlepower (the size adopted for the Panama buoys), the efficiency of the light through the lens will be 400 Hefner candlepower, visible at a range of about 11½ nautical miles. Such great candlepowers are obtainable on account of the high intrinsic

brightness of the acetylene flame, which, being relatively small in size, permits of almost exact centering at the focus of the lens. Lenses consisting of ground glass elements are now used in all modern lighthouse apparatus, the system employed for buoys being known as the Dioptric System, in which the light from the luminous source is collected and caused to travel along a horizontal plane by refraction. The sixth order (300 mm.) Fresnel lenses for the Panama buoys are composed of nine separate elements, cemented together and held securely by a brass frame of helical bars. To secure the maximum efficiency from the lens, the vertical bars of all standard buoy and beacon lanterns are equipped on their inner side with totally reflecting glass prisms, arranged so that the light which falls on any one prism is reflected out into the shadow caused by the adjacent bar. By a patented device all of the light which emanates from the lens is effectively turned to account and uniformly spread throughout the complete horizontal plane, whereas in all other types of lanterns much of this light is obstructed by the bars and lost.

Although not employed on buoys, a brief description of the sun-valve, the invention of the Swedish engineer, Gustaf Dalén, is given in closing the paper. The sun-valve controls the flow of gas to the burner so that the light will burn and gas be consumed only when actually required; that is, during darkness, thus effecting great fuel economy and increasing the service capacity of the accumulators. It is actuated entirely by light, and operates quite independently of temperature, so that it may be employed in any climate of the world. Its construction and operation are based on the well-known physical law, that a body with a light absorbing surface attains a higher temperature, and consequently expands more than a similar body with a light reflecting surface when both are exposed to the same light.

No. 5—Notes on Life-saving Appliances

BY W. D. FORBES

ABSTRACT

The greatest stress of both the American and English committees on safety at sea since the *Titanic* disaster seems to have been laid on the matter of lifeboats, that enough of these should be provided for all on board, and in the United States, at least, the construction of lifeboats has been much improved. The most noticeable advance is in making the air tanks in metal boats independent of the shell plating; in other words, demanding a self-contained and detachable buoyancy medium. In the matter of seams for the air tanks the question of brazing or riveting and soldering has been settled, allowing a folded seam, soldered, of course, in the place of a riveted or welded one. The original demand for gunwales of 26-foot boats and under was that they should be in one piece; this has been modified and a splice is now allowed. The use of a steel keel, while more expensive, is a very great gain over the use of a wooden one. It makes a stiff boat and adds strength to resist the strain when lowering or hoisting a loaded boat. There does not seem to be any great debate as to the relative values of wooden or steel boats; both are allowed, yet the metal construction appears to be rather the favorite, as it is lasting and always tight, while the wooden boat is never so.

It is clear from the investigations that life-boats are the most important lifesaving appliances; but these, of course, would be useless without efficient means of launching them, and therefore a good davit is a matter of first importance. The requirements of a good davit are named as strength, simplicity of action and perfect control. To what extent the various davits now on the market meet these requirements is explained in detail in the paper. Then the question of releasing devices and hoists is discussed. After describing the new double-decked lifeboat invented by Capt. A. P. Lundin, the author states that his ideal of lifeboat equipment includes a seaworthy boat of solid construction, davits which are worked from the ship's deck independently and with variable reach, a fall which is entirely controlled by a man in the boat, and a releasing device which can be made automatic or self-releasing when the boat is water-borne, or that can be detached at either end or both simultaneously. For returning the boat to the deck he believes a power system should be fitted to at least two boats on each side, so that for rescue work the boat can be brought up with a run to avoid being swamped in lifting. In rescue work, moreover, there is no reason why power cannot be applied as it would be available. The other boats carried would only be used if the ship was abandoned, and a quick power-return on these is not so desirable, because no master would hold boat drills in weather which would endanger lives and the boat; but for rescue work it seems that a quick power hoist is imperative, and it must be under control of a man in the boat. There are three conditions which must be considered in handling lifeboats: 1. Drill, when power is available. 2. Abandoning ship, when power would probably not be available nor would it be required. 3. Rescue work when power is available.

On Oct. 22 and 23, the United States transport *Kilpatrick* was used by the Board of Lifesaving Appliances to test out the various designs of davits, releasing devices, lifeboats and rafts, etc. The tests began with swinging out the Lundin lifeboats which were nested on the upper deck, 33 feet from the water, Welin davits being used; these are of the quadrant type. The boats proved most seaworthy and thoroughly satisfactory in every way. A most interesting experiment was tried by suspending one of the boats about 6 feet above the water and passing a line to the tug *Reno*, which hauled the boat out about 6 feet and allowed it to swing back against the ship's side. In no way were the lifesaving qualities of the boat impaired by this test. The circumstance of the test was that the *Kilpatrick* was listed 5 degrees, which at the moment of test was added to by at least 3 degrees, making a total of 8 degrees, by a squall which had come up coupled with a driving rain and a wind of about 30 miles an hour; the ship was not rolling and the Lundin boat was on the weather side; the weight of the boat was 2,259 pounds.

Later two Lundin boats were made into a pontoon. The pontoon was of the simplest construction, requiring no nailing, and only four bolts to hold it in place. This provided a platform of 575 square feet, floating 2 feet 3 inches from the surface of the water. When loaded with 91 persons, the value of such a platform for discharging stores or taking them in, landing troops with their horses, as a staging to bring boats up to, will be apparent to all military men. This pontoon was towed by a launch with great ease and maneuvered readily by four men sculling.

A lifeboat of the Ingersoll type was thrown from the deck of the *Kilpatrick* into the water. She struck bow on, almost disappeared, righted herself and was self-bailed, clear of water in 14 seconds.

A very interesting, practical and convincing test, which showed the disadvantage of the pin-type davit, was as follows: The *Kilpatrick* was listed 6 degrees, a pin-type davit fitted with a special handling device was tried, and the following time was noted:

Weight of boat, 2,250 pounds; 6 men in the boat; 7 men at the cranks. Under these conditions the boat could not be swung out. The men were taken out, and the 7 men heaving at the cranks were hardly able to get the boat outboard in 5 minutes 10 seconds. Later, with 7 men in the boat and an extra effort of the 7 men, the boat was got out in 8 minutes 2 seconds, but the men at the crank had to be "spelled."

Under the same condition of list the quadrant type of davit showed:

Weight of boat, 3,250 pounds; 11 men in the boat; one man at each crank; 1 minute and 40 seconds.

With a round-bar davit and the ship on an even keel the time given below was required:

Weight of boat, 2,250 pounds; 18 men in the boat; 10 men at the davits; 5 minutes 15 seconds were required to swing it outboard; only damage done was a little denting of the bow when she went over the side. This boat was fitted with square holes for bailers, which passed directly through the deck, and also the plating, with no obstruction whatsoever. It came on to blow, and this boat could not be made fast to the falls, so she was towed astern, and with these open scuppers the effect was very much that of a system of miniature geysers. Later boats of this construction are provided with means to prevent this.

A number of releasing gears were tried out, all with more or less success; in fact, it might be said that all of them performed the operations expected of them, but only one of them seemed to meet the demands of absolute simplicity.

No. 6—Developments in Oil Burning

BY E. H. PEABODY

(This paper will be published in the January number.)

No. 7—The Preservation of Metals Used in Marine Construction

BY LIEUT. COMMANDER FRANK LYON, U. S. N.

(This paper will be published in the January number.)

No. 8—An Electrically Propelled Fireproof Passenger Steamer

BY W. T. DONNELLY AND G. A. ORROK

(This paper is published on page 498.)

No. 9—Notes on Fuel Economy as Influenced by Ship Design

BY E. H. RIGG

(This paper is published on page 496.)

No. 10—Active Type of Stabilizing Gyro

BY ELMER A. SPERRY

Abstract

The stabilization of ships has been undertaken by two methods: First, by changing the center of gravity of the mass as a whole, as by the damping tanks of Sir Philip Watts and later workers, and the moving weights already successfully applied by Sir John; and, second, by employing the already very great longitudinal stability or rigidity by deflecting same in to the athwartship plane. The ship by this means may be rendered stable almost without limit and up to the breaking-down point of the gyroscopic couple, which has now come to be recognized as of simple origin and of very great magnitude, especially as compared with the weights involved.

Some of the early attempts to use the gyroscope were unfortunate in that the gyro was passive, therefore free and uncontrolled as to its precessional movements. Experience has now been had in actual sea trials which confirm statements often put forward by the author heretofore, urging the great importance of having these precessional movements of the gyro at all times under perfect control. This control on the one hand sets a constant limit to the otherwise almost limitless power of the gyro couple, while on the other hand it allows us to apply a measured stress of any desired magnitude, duration or direction and timed with precision. In this manner the very great longitudinal metacentric height is available for athwartship purposes, and may be in any desired amount added to the athwartship component. In fact, the point has now been reached in this development, as demonstrated by sea trials, that the amount of the great longitudinal stability utilized athwartship may be always quantitative and proportional to the needs. With the adjunct the ship itself may be very tender and of low metacentric height, because, as above stated, any desired amount of the very great longitudinal metacentric height may be added at will athwartship, and this without any regard to the rolling period of the ship. In this manner a comparatively small apparatus can be utilized in effectually holding the ship against motion, simply because each increment on the instant, and simultaneously with its development, is completely subjugated and neutralized before it has time to move the ship.

The gyro constitutes an ideal apparatus for this work, inasmuch as it is perfectly safe. It is unnecessary to run the wheel at any but comparatively low stresses. In fact, the stresses present can be brought below those used in hull practice. The comparatively slow motion of the wheel is very inexpensive to develop and maintain, representing only a small fraction of the power required to propel bilge keels; and this power, small as it is, is only required when the necessity for stabilizing arises, and then only in proportion to the seas running at the time, whereas the power for the bilge keels is omnipresent; that is, it is a constant drag in all weathers. The power for operating the precession is trifling, only sufficient to absolutely control and limit the precession movements at all times. This arises from the fact that the constant tendency of the ship is to do precession-wise work upon the gyro. The power required for the precession engine is almost nil, it being only sufficient to control the implacement of the positive and negative energizations delivered to the ship.

The paper discusses the advantages of the active type of gyroscope as compared with other methods of stabilizing ships. The gyro equipment of the U. S. S. *Worden* is described in detail. In closing the author states that our knowledge of the amount of work derived from the active stabilizing gyros herein described, while acting under these new conditions, is now such as to enable us to calculate with all necessary accuracy the weight and space occupied in connection with any plant; also to predict with accuracy what the results will be, the amount of power required, and also to prescribe, with a fair degree of certainty, about what stabilizing factor under the new *modus operandi* would be satisfactory with any given ship.

No. 11—Rudder Trials, U. S. S. Sterett

BY ASSISTANT NAVAL CONSTRUCTORS R. T. HANSON AND J. C. HUNSAKER, U. S. N.

Abstract

The objects of these trials were: (1) To determine the moment of pressure on the rudder in turning at varous speeds and helm angles; (2) to compare these values with the corresponding values given by Joessel's formula, and to obtain a coefficient of reduction thereon; (3) to establish a formula directly applicable to this particular type of vessel, and (4) to investigate the condition of "meeting ship" with the helm when already turning, and the condition of turning with engines reversed.

It is believed that previous published turning trials have been conducted at speeds not greater than 20 knots, and that particular interest attaches to these trials on account of the high speeds (28 knots maximum) at which they were run.

The trials for the conditions of "meeting ship" and "backing" were made for the purpose of obtaining data which, it was hoped, would be of interest in the design of steering gear for ships of a type similar to that tested.

For these turning trials, the U. S. S. *Sterett*, a destroyer of recent design, was designated by the Navy Department. The trials consisted in securing, with a recording spring dynamo-

meter, a continuous record of tension in the standing part of one tiller chain, together with records of time, helm angle and revolutions of both turbines.

The results of the tests have been summarized in curves of twisting moment, both maximum and on steady turning, coefficients of reduction on Joessel's values and an approximate empirical equation.

Turning trials underway were carried out in Massachusetts Bay in the vicinity of Boston Light Ship. The sea was smooth with a long ground swell. The mean displacement of the ship was 835 tons, 12.7 percent greater than the displacement on standardization. The depth of water in which the trials were run varied from 12 to 20 fathoms.

The procedure for a run was as follows: The ship was put upon a steady course at the desired speed (the corresponding revolutions per minute being maintained as nearly as possible except during actual turning, when the throttles were not touched). After steadying on course and speed for a reasonable length of time, a "stand-by" was given to the engine room and to the man in charge of the dynamometer and gear aft. The order was given to the helmsman "starboard 25 degrees," etc., and simultaneously a "start-turn" signal was given by bell to the engine room, and a "jog" transmitted to the record roll. As the ship's head swung past 10 degrees, 20 degrees and 30 degrees by steering compass, one, two and three notches were transmitted to the "signal" line on the record roll. Since a practically steady value of stress was in every case reached at 40 degrees to 60 degrees of swing, the turn was considered finished after swinging through eight points. The helm was then put amidships and the ship steadied on her course at the speed desired for the next turn. On each turn the time to put helm over was checked on a stopwatch, and the helmsman was coached to secure a uniform rate. The average rate at which the helm was put over was 3 degrees per second.

For convenience the tests were begun at the lowest speed. The "meet ship" turns were run in wherever the speed of ship, and capacity of dynamometer spring already fitted, made it convenient. The full-power backing trials were made immediately after the turns at maximum speed ahead, and the trials were concluded with the backing turns at reduced power.

Three turns were made at each helm angle; four different helm angles were used at each speed, and there were five speeds ahead, in addition to "meet ship" turns and full power and reduced power backing turns. The total number of turns made was 74, and the total time required was seven hours.

The "meet ship" turns consisted in steadying on a course at prescribed speed, then putting the helm first port a certain number of degrees, then starboard. Continuous records were made and maximum and "steady" stress obtained for various conditions, such as "meeting" the ship with starboard helm immediately after the helm had been put aport, and "meeting" her at various intervals of time after the ship's head had begun to swing to starboard.

Backing turns were made both at full power and at reduced power. The backing turns at full power are of particular interest, because they give twisting moments more than 1.5 times as great as the maximum moments obtained on the turns at the highest speeds ahead.

The instant the helm starts to move, in beginning a turn, the force recorded on the dynamometer begins to rise, and reaches a maximum at about the instant the helm reaches its maximum angle. During this time the ship first gives a slight kick to starboard (assuming helm put to starboard), then starts to turn to port. As she continues to turn, the tension in the tiller chain falls off somewhat and then maintains a practically uniform or "steady" value after a swing of 40 degrees to 50 degrees. The ship then turns uniformly in her normal turning circle, and as there is practically no further variation in the ordinate of the force curve the turn is considered finished after a swing of 90 degrees. As soon as the helm is put back amidships the tension in the tiller chain falls rapidly to its initial value.

The data obtained in these trials are presented in tables and curves, and a formula is proposed for twisting moments in terms of the rudder constants. The conclusions set forth from these trials are as follows:

1. A given coefficient of reduction for Joessel's formula may be applied to similar ships, with rudders of the same type, only for the same helm angle and at corresponding speeds, i. e., $\frac{V}{\sqrt{L}} = \text{constant}$.

2. In turning with the helm alone, the maximum tension in the rudder chain (including friction of gear) occurs at the instant the helm has reached its extreme position, and amounts to 139 percent of the tension when the ship is turning uniformly at 28 knots and 35 degrees helm.

3. The maximum twisting moment on the rudder post occurs at the same instant as (2) above, and amounts to 130 percent of the moment when ship is turning uniformly at 28 knots and 35 degrees helm.

4. The rudder moment to "meet ship" when turning amounts to about 112 percent of the moment, exerted in steady turning with same speed and helm.

5. The effect of waves of height about 4 feet is to produce a maximum moment when turning of 135 percent of the maximum moment when turning in quiet water.

6. The force exerted by the steering engine to overcome the friction of the leads to the rudder yoke is 24 percent of the maximum force exerted on turning at 28 knots and 35 degrees helm in quiet water. This seems to be a disadvantage of a location of the steering engine forward in a ship of such length.

7. The greatest moment measured during these trials was obtained in backing full power with full helm. The rudder moment for this condition amounted to 1.6 times the moment recorded on steady turning at 28 knots and 35 degrees helm.

With the results of these rudder trials at hand it would be of interest to determine, with precision, the path of the *Sterett* in turning with a view to establishing the relation between the rudder moment and the maneuvering qualities of this type of ship.

To afford data for the design of steering gear and rudder posts, using a definite factor of safety, such rudder trials as are described in this paper should be conducted in rough weather.

No. 12—Logarithmic Speed-Power Diagram

BY THOMAS M. GUNN

ABSTRACT

To logarithmic diagrams of one type or another the modern engineer is indebted for the rapid and easy solution of many cumbersome formulæ. The calculations which yield themselves most readily to its use are those involving products, quotients or powers of numbers. It matters little what the exponent is, the solution of a formula consisting of (a constant) × (a variable) raised to any known power, requires for its repeated solution only the drawing of one straight line, and thereafter for any value of the variable within the range of the diagram the result is read off directly. For such purposes it is common to use logarithmic co-ordinate paper, which is available in two or three sizes. Diagrams have already been used repeatedly for the calculation of frictional resistance of ships. It is not desired in this paper to present new information upon the power of ships or propellers, but rather to sub-

mit a means of convenient application of the laws of comparison for ships and propellers.

The following table summarizes some of the commonly known relations between similar ships of different size. For convenience, all of these relations are stated in the last column in terms of speed:

Function.	Quantity in Proportion to which Function Varies, in Terms of: L.	D.	V.
Length or other linear dimension, L	L	$D^{1/3}$	V^2
Surface, S	L^2	$D^{2/3}$	V^4
Speed, V	$L^{1/2}$	$D^{1/6}$	V
Displacement, D	L^3	D	V^6
Wave resistance (residual)	L^3	D	V^6
Wave power	$L^{7/2}$	$D^{7/6}$	V^7

The fact that both the exponent and coefficient of friction vary in the formula for frictional resistance makes it impossible to introduce this term directly in the laws of comparison. Detail calculation shows that if frictional horsepower be calculated for two similar surfaces at corresponding speeds, the ratio of horsepower is very closely approximated by the 6.735 power of the speed ratio, or the 3.3675 power of the length ratio.

This relation holds most closely for surfaces above 50 feet in length, but is a good approximation even as low as 10 or 15 feet in length.

Since friction power of the ship varies nearly as the 6.735 power and residual power as the seventh power of the speed for similar hulls at corresponding speeds, it may be expected that their sum or effective horsepower will vary as some power of the speed between 6.735 and 7. It is somewhat variable, dependent upon the ratio between frictional and total resistance or power.

In common practice the power consumed in surface friction is from 50 to 60 percent of the effective power, as low as 40 percent only in very high-speed craft, and dropping possibly to 10 percent in hydroplanes or rising to 90 percent at low speeds for long cargo vessels. It may be stated that for normal designs, from full boats of low speed to fine forms of high speed, there is not much error in assuming the exponent of reduction to be about 6.866.

The application of the logarithmetic diagram to these calculations and to propeller problems is explained in detail in the paper, a full comprehension of which can be gained only by consulting the numerous diagrams which accompany the paper and which cannot be reproduced in the limited space available for this report.

No. 13—Tool Steel for the U. S. Navy

BY LEWIS HOBART KENNEY, B. S., M. E.

Abstract

Previous to 1909 each navy yard prepared requisitions for the purchase of tool steels for its own purposes. The requisitions specified either proprietary material or that the contract would be awarded from information obtained by a test of some description of samples submitted by the bidders. By this method there was no uniformity in the specifications of the navy yards. In order to centralize the purchase and standardize the tool steels for the navy yards, a tool steel board in 1909 recommended that the Philadelphia navy yard be the purchasing station, and prepared specifications for one "high-speed" and three carbon tool steels.

The chemical composition of the "high-speed" tool steel differed from any of the commercial tool steels, and the carbon tool steels were varied principally in the carbon content, in order to adapt them to the purposes for which such tool steels are generally used. The contracts were awarded under these specifications to the lowest responsible bidders for tool steels of a chemical composition within the specification limits. As part of the inspection for acceptance of the material physical tests were prescribed in addition to the chemical analyses, but the physical tests never gave satisfactory or decisive results, and evidently were not co-ordinate with the chemical compositions. The specifications did not provide a means for either ascertaining the relative merits of the tool steels offered by the bidders or if there were better tool steels than those within the limits of the chemical compositions specified.

It was, therefore, considered advisable to revise the specifications so that the bidders would be required to submit samples of the tool steels covered by their bids. The samples would be manufactured into tools, and subjected to physical tests devised to investigate the relative merits of the samples submitted. The data thus obtained would form the basis for recommending the award of contract. The chemical compositions would be given with maximum and minimum limits, in order to indicate to the bidder the kind of tool steel required, but as the physical test would form the basis for recommending the award of contract a statement would be included to the effect that the bidders could submit samples of chemical compositions differing from those specified. The object of this provision was to introduce competition as to the qualities of the total steels instead of simply competition in price.

By modifying the specifications as outlined above a means would be provided for learning something of the relative merits of the commercial tool steels, and for taking advantage of the developments and progress made by the manufacturers in this subject. Definite information would also be obtained of the qualities of the tool steels before the contract was awarded for their purchase, which is evidently a decidedly important matter.

The study of tool steels, which the adoption of specifications as outlined above made possible, is under the direction of the Engineer Officer, Navy Yard, Philadelphia, Pa. The subject practically divides into the two general classifications of "high-speed" tool steel, or tungsten tool steel, Class 1, as it has been designated in the later specifications, and carbon tool steels. The "high-speed" tool steel was considered the more important, and its study was, therefore, undertaken first. The paper has been divided into the following sections:

(*a*) Tungsten tool steel, Class 1, development of specifications.

(*b*) Carbon tool steels, development of specifications.

(*c*) Description of selective tests.

(*d*) General notes.

Sections (*a*) and (*b*) have been subdivided to represent the successive schedules under which tool steels were purchased.

Each of these sections is discussed in detail and amplified with lengthy appendices and numerous charts, showing what has been accomplished in this important department of naval work. When the Philadelphia navy yard was selected as the purchasing station for tool steels, there was no information on file as to the dimensions or amounts of the several kinds of tool steels which would be needed by the navy yards per annum. Tool steels were, therefore, purchased under the specifications then in force from time to time as required. This method required advertising for bids at intervals and caused delays in delivering to a navy yard the tool steel it had ordered.

The expense of a selective test as described in the paper would be prohibitive if it were to be made to determine the award of contract for small quantities of tool steel. It was therefore decided to recommend the purchase of a six months' supply of tool steels in order to test the specifications, reduce the ratio of the cost for the selective test and the cost for the entire amount of steel purchased to a minimum and to get a stock in store.

The selective test, as adopted, indicated that only minor

modifications of the specifications were necessary, and it was therefore considered safe to recommend that an annual contract for tool steels be made, the contract to be so framed that tool steels of any reasonable dimensions and in accordance with the classification of the specifications could be ordered in any desired quantities throughout a fiscal year. A schedule was prepared to meet these requirements, and an extract made from it is given in the paper to explain the general scheme.

No. 14—The Sperry Gyro-Compass in Service

BY LIEUT. R. E. GILLMOR, U. S. N.

ABSTRACT

To be in service an instrument such as that with which the paper deals must have passed the experimental stage—the stage of trial and development. It must have emerged from that stage in a form which is fundamentally sound and practicable. It must have demonstrated its value and have been placed in actual service. This has all come to pass and the old approximate, magnetic compass, with its many errors and weaknesses, is being superseded by an accurate instrument which gives us our true course at sea, is unaffected by magnetic or physical forces tending to deviate it; is simple and substantial, requiring little care or supervision.

Early in this work the inventor became convinced that the major problem was one of pure engineering in devising a suspension which would be frictionless about the vertical axis, allowing the gyroscope to turn with perfect freedom in its effort to seek the meridian. In the most powerful gyroscopic compass which has ever been devised, the maximum directive force (axis at 90 degrees from the meridian) exerts a power which is equivalent to only .015 watt-seconds. This decreases in proportion to the cosine of the angle which the axis makes with the meridian until, when the axis is exactly on the meridian, the directive force is zero. The suspension must be such that the gyro is free to return to the meridian under the very minute directive force exerted when the axis has left the meridian by only a small fraction of a degree. The solution of this problem alone involved years of experimental work, inasmuch as no ordinary suspension could be used because of the weights involved. The problem was finally solved by suspending the gyroscopic, or sensitive element, from a stranded wire, the top of which is carried in a frame surrounding the gyroscopic element, this frame being oriented by an electrical follow-up system in such manner as to cause the frame to follow any tendencies of the gyroscopic element to move about the vertical axis. This constitutes a highly frictionless suspension, with the result that, while great power is available for driving the compass card and repeater transmitting system, the gyro itself has extremely little work to do, and consequently can be made very sensitive while running at quite moderate speed. This suspension has made possible a durable and, at the same time, a very sensitive instrument. Numerous other problems, quite as difficult of solution, were encountered. The manner in which all of these problems were solved, resulting in a strong and accurate instrument, is explained in the paper by a detailed description of the gyro compass as it is constructed at the present time. With the gyro compass it will be possible to navigate the ship accurately in any sort of weather and without taking observations to check the position. Observations would, of course, be taken in good weather as an additional safeguard. The installation of the instrument involves nothing complicated, inasmuch as the only adjustment necessary is to properly place the lubber's point so that the true angular position of the ship's head is always shown.

The first compass was installed on board the Old Dominion Line steamer *Princess Anne*. It was placed at the farthest possible point from the ship's metacenter, so as to obtain the maximum effect from the rolling and pitching of the vessel. A voyage was made with the compass from New York to Norfolk and return. During this time the ship rolled as much as 26 degrees on each side of an even keel. Close observation of the compass failed to disclose the slightest deviation due to this motion. Tests were made by quickly changing course and speed to ascertain whether or not any oscillations were induced by the acceleration pressures so impressed. Following these trials installations were made on the U. S. S. *Drayton*, a torpedo boat destroyer, and on the U. S. S. *Delaware*, a battleship. The satisfactory performance of these installations resulted in a contract for supplying the navy with eight complete gyro-compass outfits. These were installed on board the U. S. S. *North Dakota, Florida, Utah, Michigan, Arkansas* and *Wyoming*, and on the submarines *E*-1 and *E*-2, and since then ten more compasses have been contracted for.

A Tribute to the Titanic Heroes

In his address, delivered at the twentieth annual meeting of the Society of Naval Architects and Marine Engineers, Mr. Stevenson Taylor, president of the society, paid the following tribute to the brave men in the engine room of the *Titanic*:

"The one overwhelming event of the year, which more than any other directly interests naval architects and marine engineers, was the loss in April last, with its awful consequence, of the splendid *Titanic*, the latest work of one of the great shipbuilding yards of the world. No previous disaster at sea, great as some have been, ever produced the consternation and appalling feeling of man's impotence that was caused by the foundering of what was considered the last word in ocean steamship construction. This terrible event has been the occasion of investigation at home and abroad, with sundry conclusions as to the responsibility for the disaster and the need of changes in the various requirements for the future. All naval architects are aware of all that has been said and done, for a matter of such vital interest to everybody must have received from every member of the Society of Naval Architects and Marine Engineers the closest attention and most careful consideration. The disaster has been attributed, perhaps, to a combination of circumstances never happening before, in which combination occurs human judgment, upon which, in all walks of life, in all spheres of action, so much must depend. Where human judgment is concerned a tribute must be paid to those in the engine rooms at the time of the disaster. In our work we meet and know this class of men. Far below in the depths of the ship they well knew long before those on deck of the fatal hurt the ship had received. Of those directly employed by the steamship company who were called to their places as a matter of regular duty, and of those on assumed duty in behalf of the builders, who were at the time in no way responsible for the management of the ship, not one was saved. There were many glorious examples of heroism on deck, but none more glorious, none showing greater self-sacrifice than the example given by that splendid engineer corps, remaining below awaiting the end without the slightest possible chance of life. All honor to those true, brave men!"

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The American Society of Mechanical Engineers will meet with the Verein Deutscher Ingenieure in Germany, June 21-July 7, 1913. Members and guests of the American society will leave New York June 11, and the itinerary as planned offers a most remarkable tour of the industries of Germany.

Communications of Interest from Practical Marine Engineers

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs

The Engineer—Marine or Stationary?

For the young man who wishes to become an engineer it is sometimes difficult to decide which course he will pursue, whether to become a stationary engineer or a marine engineer. When he is in doubt opportunity and circumstances often decide the question for him, but nevertheless much has been written regarding the advantages and disadvantages of each, and the beginner naturally wants to know which course is preferable and why.

In large power stations may be found many engineers who have followed the sea and hold a marine license; also from chief engineers of power stations it has been ascertained that the marine engineer is much in demand on shore, the reason for this being that the engineer who follows the sea in ships of large tonnage, especially in the large express steamers, has a greater variety of duties to perform with which the engineer on shore never comes in contact. The chief engineer who is a marine man is schooled in discipline as well as in mechanics. He learns discipline while holding a subordinate position, perhaps as third assistant engineer, where he must direct successfully men who are not ambitious but who are simply a part of the human machinery of the engine department, This is sometimes a difficult task and requires much patience and persistence which is not known to the stationary engineer. The men in the engine department on board ship are there to work and perform the duties for which they were shipped. The engineer at sea cannot tell a fireman that he is discharged —nothing of the kind can be done. The fireman is there to work and complete the voyage, unless he is physically indisposed, and in such an instance it should be noted that the ship's surgeon is not an "easy mark" by any means, and if a case of sickness is found to be false the "knight of the coal shovel" will soon find himself back at his furnace doing the bidding of the third assistant engineer.

"All is not gold that glitters." The young man who looks on the shining cylinder heads of a marine engine knows nothing of the dirt in the bilge, nor has he felt the roll of the ship or the pitching in a head sea, or the nauseating smell of hot, burning engine oil dripping from a steam pipe until he has come in contact with it. Hot water and bare steam pipes are a constant source of worry and disgust to him, and he will probably soon be strongly tempted, as the boys say, "to chuck up" his job. But on reaching port and smooth water again he decides to try one more trip, and thus he gets the fever, and then the habit, and it is hard to get away once you have become acquainted with the Old Man Neptune, for he has a hold which it is hard to break. At sea your meals are regular and, although your work is hard, you have a good appetite, which, of course, is not saying that your appetite is always satisfied; but, nevertheless, plain food and plenty of it does wonders for the ambitious young man.

The chief engineer of one of the Sound steamers of the Fall River Line was asked for his opinion as to which was preferable, an engineer's life on shore or afloat, and his prompt reply was "an engineer's life on shore is preferable. A man on shore in a large plant has a much better position." Being asked as to why this was so, he gave many and various reasons, one being that it was worth more money, which, of course, would rule the majority. But the young man who is interested in his work leaves this as a secondary consideration; for in his earlier years knowledge and practical experience are, or should be, what he is after. Much of this he can obtain by keen observation and a sensible question asked now and then. Generally the desired information is cheerfully given, and then, again, sometimes you don't get it. Some of the old school engineers think the young fellows are too progressive, and, in a certain light, they look dangerous, but, on the whole, you will find marine engineers to be a fine class of men and conscientious to a point almost unbelievable.

Marine engineering is a combination of theory and practice, and to follow it successfully requires much study and planning, and a man should read much in his spare time and compare notes with the fellow on the other boat. The man who does not read, does not progress. He is at a standstill and just performs the routine duties of his position, and nine times out of ten his hand never reaches the pen in the office of the local inspector who issues the marine engineer's license.

The young man who wishes to go to sea and become a marine engineer, unless he is far-sighted, may think it will be a humdrum life, but, as a matter of fact, there is something to look ahead for. The marine engineer may not always follow the sea; and if he gains a reputation for sobriety, trustworthiness, and is an economical man and a good mechanic, and maintains good discipline, many good positions are open to him on shore; for the training he has received on shipboard is quite an asset to the corporation which desires his service. The marine engineer must depend on his own ingenuity many times for temporary repairs, whereas his brother on shore can have parts repaired or refitted for him without worrying much about it. Of course, he is directly responsible for the repair work, but the repair man usually furnishes the tools and does the work in the usual way. Also, there is usually a machine shop around the corner, and the repair work is not such a tax on the engineer's ability as it would be at sea, where he has to depend largely upon his own resources.

Opinions regarding the qualifications of a successful engineer have changed greatly in the last few years. It used to be thought that the chief engineer should be quite an old chap with years of practical experience, and theory did not count for much. A very interesting illustration of this occurred recently to a young man who applied at a sawmill in one of the Northern New England States for a position as engineer. He was told that he was too young and had not had enough experience. Much humiliated he went away, but the next year he happened to be in that vicinity again and he thought he would see what kind of a man was holding the position. He found that the present incumbent was quite an old gentleman with a strong resemblance to Santa Claus. He had a long white beard and was considered by the superintendent to be an engineer of unsual ability. The young man remarked to the venerable engineer with the whiskers of great length that the last time he was in that place the engine was turning to the right, but that this time she was turning under or to the left with the belt crossed. In explaining this unusual occurrence the old engineer remarked that the engine had started the wrong way one morning, and being unable to determine the cause for this they had crossed the belt, and, outside of a large-size bump, she was running first rate. Poor old chap! Who knows but that perhaps some morning he will start the engine up and perhaps the eccentric will slip just enough to start her the other way, or perhaps she won't go at all From

this it may be readily seen that the time served and the experience and practical knowledge gained differs greatly with men.

The young engineer should train his powers of observation and keep a memorandum book with examples and facts correctly written therein, which will be of great assistance to him many times. The best preparatory school for the engineer, whether he is inclined to adopt the stationary or marine practice, is the engine-building shop. Isaac N. Cory.

New Bedford, Mass.

A Word as to Boilers

It is true in many cases that no part of marine machinery receives more abuse than the steam generator. In placing a contract the owner will try to get as cheap a job as possible, never considering that during the remainder of the plant's life he will spend large sums for fuel, and perhaps for large repair bills. Go on board many ships and take a look at the boilers. In numerous cases we see a state of affairs that is absolutely startling. What is there to keep oil and grease out of the boilers? At what temperature does the feed-water enter the boiler? The writer some few years ago examined a boiler of a coastwise ship. This boiler was of the leg type, and had he been told that it was coated with grease he would not have believed it. As a matter of fact, however, the boiler was worse than coated. The stays were covered with a nice, thick coating of grease, which was well baked on. On the back connection, on the crown sheets—in fact, on every place one could see—there were signs of oil, and he wondered that it ever kept together and that there never was a loss of life and floating property.

Some time ago a large ocean-going tug was fitted with a new boiler. At the time the boiler was being built repairs were also made to the machinery, and in the latter was the reboring of the high-pressure cylinder. This tug was fitted with a heater and grease extractor. After the tug was in commission complaints were made regarding the coal consumption. An investigation showed that the grease extractor was not used. The heater coils were covered with grease, and the boiler was thoroughly saturated with grease and oil. Upon seeking a reason I found that the engineer had no time to renew the cartridge and he had been using great quantities of oil in his high-pressure cylinder.

Now, there are ships running that have no grease extractor, and many are without heaters, distillers or evaporators. The reason for this is simply the question of first cost. Yet many times the price of these outfits is paid for in the saving on coal bills, and that in a comparatively short time. What is the cost of a grease extractor compared to the cost of a furnace, plus the loss occasioned by a tie-up? It is not my purpose to talk feed heaters, grease extractors or other specialties. I am, however, at a loss to understand how owners can ignore this vital part of a ship's plant. Aside from the enormous loss of efficiency as a steam generator caused by grease and oil by the introduction of feed at a low temperature, enormous strains are put up in the structure, and often cause trouble, which likewise is very costly. We know that distilled water is not good for a boiler, and to avoid any trouble we simply use enough salt feed to give the boiler a fine coating of salt. It is a very poor plan, indeed, to use oil in the cylinder of a new engine, and it should be worked without it. There will, however, be a very slight amount of oil introduced into the cylinders, especially in the low-pressure cylinder, from the swabbing of rods.

There is not to-day a grease extractor that will take all the oil out of feed-water. Oil can only be entirely eliminated by taking it out of the steam. If we had a grease or oil extractor placed in the eduction pipe we could practically eliminate all the oil. Take, for example, a piece of plate, say No. 16 B. W. G., and form it so that it will hold a small quantity of water. Before introducing the water smear a portion of the surface of plate with a small quantity of oil; then introduce the water, place the plate over a candle, and note what takes place. It is a very interesting sight, and one would be surprised to see what happens. Further, we can readily understand why crown sheets come down.

A well-made boiler is a dependable thing, and when properly proportioned and designed, as well as properly handled in service, is capable of showing very high efficiency. It matters not, however, how well designed or built if its treatment in service is bad. A man will pay thousands of dollars for a race horse, and he sees to it that his animal is treated with the greatest care and that everything conducive to its longevity is obtained. Why? Because it is a source of revenue. Yet a boiler, costing more, and being even a greater source of revenue, is permitted to be handled by ignorant attendants, and anything conducive to increased efficiency is considered too costly to install. Think of the boilers to-day on so-called modern ships, let alone in stationary plants, which are treated to a good surface blow every day to get rid of the oil and scum carried over from the use of oil in the engine! Is this heat worth saving? Does it not represent money? Does it not represent energy going to waste? Does it not denote terrific strains on the boiler itself? Does it not show lack of appreciation of cause and effect? The answer may be that we have not enough auxiliaries to heat the feed. Yes, that may be true enough, and theoretically there is no gain by heating feed-water with steam direct from the boiler, and a little thought will make the reason clear; but there is a gain, a vast gain, in the life of boiler, because the strains are eliminated. If the strains put up were constant and not intermittent in character, they would not be so dangerous; but is it fair to suppose that intermittent stresses are set up and no injurious effects follow? I do not think so. These are abuses that can be remedied, and should be, aside from the question of fuel economy. It requires the closest contact between the gases and the walls of the boiler and between the wall and the water for efficient transmission of heat from the gases of combustion to the water. If this condition must obtain, then we will have to keep all foreign matter out of our boilers. We all know that the most efficient heating surface is that of the furnace crowns and combustion chambers, this being, of course, due to the difference of temperature between the two sides of the plate. Then there is freedom of the surfaces from deposits of soot or ash, and if proper precaution is taken freedom from mineral or earthy matter.

Now, as for the remaining parts adding to heating surface, we can eliminate them in the present article, as the above-mentioned surfaces are those affected by grease and oil. If I could picture the condition of some boilers which I have examined internally, I am sure it would hardly be credited. Yet the fact remains that such conditions did obtain and still obtain, and many boilers are filthy and the line of oil marks are clearly shown. At one time in the history of the steam engine, I will grant, cylinder lubrication was a necessity, and the old grease cup on the top of cylinder heads was considered a thing of beauty and a joy forever for the engineer. In the present-day conditions it is not necessary. If kerosene (paraffin) is at times introduced into the boiler it not only insures a harmless lubricant but at the same time a most efficient one, as the cylinders and the surface of cylinder walls soon take on a magnificent polish, and, again, there is a chemical action which hardens the surface, and in a period of time the walls reflect like a mirror.

What is the gain by using a feed-water heater? Let us first suppose that the water is fed to the boiler at a temperature of 110 degrees, and, further, that the working pressure

is 180 pounds gage or 195 pounds absolute. We will assume that 8 pounds of water are evaporated under these conditions per pound of coal. The total heat of steam at a pressure of 195 pounds absolute is 1197.5 British thermal units per pound. The temperature of the feed-water being 110 degrees we have 1197.5 — (110 — 32) equals 1119.5 British thermal units added to each pound of water passing through the boiler. Now, as 8 pounds of water are evaporated per pound of coal, we have 8 × 1119.5 equals 8956.0 British thermal units. Now suppose a heater is installed and our feed-water is to be raised to 212 degrees. To generate steam of 195 pounds absolute pressure from a feed of 212 degrees requires 1013 British thermal units, which is made up of the latent heat (845 British thermal units) plus 168 British thermal units, the sensible heat (168 British thermal units). We therefore have 8956 British thermal units, divided by 1013 British thermal units equals 8.84 pounds, or a gain of 10.5 percent. It is the practice, however, to heat the feed to 215 degrees and 220 degrees F., resulting in a gain of about 10.5 to 11 percent. It is unnecessary to carry this further.

Is it worth saving? Is the life of the boiler worth prolonging? Is the boiler to be credited with low efficiency because it receives but scant consideration? Is the engine to receive every consideration, while the steam generating plant is passed over with only sufficient interest to warrant the production of sufficient steam to enable the engine to turn the wheels and thus propel the floating body?

We are in latitudes where the coal pile is getting to be of some consequence, and where the boilers have to receive some scientific consideration. There is plenty of room for improvement in design, and there must be a more scientific method of handling when under way. There is no excuse for having dirty boilers, nor is there any excuse for having crown-sheet trouble caused by grease. It would take more space than can be given in this article to compare the cost of prevention and the cost of new furnaces. It would, however, be an interesting comparison.

I cannot close this without mentioning a case that came under my notice about three years ago. I was requested to go South and at a certain point meet a large ocean-going tug, bring her to Baltimore, and there make a complete examination and report, as on my report the boat would either be accepted or rejected. After the boilers had cooled down I went through them, and never inspected more finely-kept boilers; there was not a trace of grease in any part, the waterline was a well defined line, and I could take my fingers and erase all sign of it. It was properly coated with salt, just enough to prevent any injurious action of the water. The steam space was perfect, and one could have gone in those boilers without getting his clothes soiled, as the deposit of salt would brush off. There was no sign of pits; and, furthermore, no damp ash was allowed to accumulate around the front, and therefore no corrosion due to this cause was able to take place. The boilers, at that time, had been three years in actual, hard service. There was no indication of any part being strained; furthermore, there was not a sign of a leak of any kind. These boilers were built by the Harlan & Hollingsworth Corporation, Wilmington, Del., and were characteristic of their boiler work.

I have not since or do I ever expect to see finer treatment given boilers than these received, and the efficiency was very high. I had the pleasure of seeing a boiler plant a few days ago where the boilers receive first consideration, and here were boilers furnishing steam to a triple-expansion engine and the necessary auxiliaries; the feed temperature is held at 215 degrees F. The efficiency of this plant, taken from log entries, is very high, and I may say the thermal efficiency of the engines is likewise high; in fact, higher than that which ordinarily obtains. I can mention several ships of this line that show very high evaporative efficiency and where the boilers are the first consideration, and the superintending engineer, as long as I can remember, has been considered a crank on the boiler question, but results have amply justified his demands that the boilers receive certain proper treatment, and for the size of their ships they are the most economical and efficient.

We can design and construct, and on these points we can exercise judgment and produce a fine piece of work. In actual operation, however, we have no control, and it matters not how we design to satisfy all conditions of stress and strain; if the necessary precautions are not taken and the required preventatives adopted the boiler will not, and cannot, be efficient, and above all the attendants must be instructed and made to handle the boilers in a more scientific manner. Sludge, grease, excessive strains, and leaks caused by them, can be eliminated, dropped crowns can be likewise eliminated and money saved. It is up to the owner whether he wants dividends from every item of his plant or is satisfied to pay coal bills and tries to "grind" down builders in the cost of construction. The latter is the spigot, the former the bung-hole, and let us ease up a little on the poor spigot and get after this bung-hole, which is very much larger.

New York. CHARLES S. LINCH.

Duplex Pumps

A steamer in which the writer served as third engineer had a duplex ballast donkey with which the chief expressed himself as very dissatisfied.

The pump in question was overhauled and apparently worked fairly well, but the chief seemed to have a grudge against it. He was always complaining that it did not work correctly. Finally he tried a new method of his own to adjust the valves. While steam was on the pump he uncoupled the valve links and gave the valve rod half a turn, opening the valve to steam to see the effect, repeating the dose at his discretion. The looked-for happened after a while; to the great amusement of us juniors he miscounted his turns and carried away the link motion altogether.

It is my opinion that the majority of my seagoing colleagues do not understand the mechanism of the duplex pump. It gets the hardest service, any amount of abuse and no thanks. It puts up with treatment that would put out of commission any other engine room auxiliary. Space and price considered it earns its keep handsomely. My experience may be unusual, but no engineer I was ever shipmates with really understood the duplex pump, and it is with this in my mind that I write. It was my good fortune to come across two men at different times who had made a life study of pumps, and for the benefit of the large number of my colleagues who have not had this good fortune I wish to pass on to them the results of my tuition.

TO SET THE VALVES OF A DUPLEX PUMP

(1) Set both piston rods in mid position. To do this force the piston rod one side of the pump, using the cross-head and not the links until a satisfactory bump is obtained on the cover by the piston; mark the rod by scribing from the face of the stuffing-box. Now bump the other end of the cylinder, and by measurement obtain the distance between the first mark and the stuffing-box face. Now make a mark on the rod in the center position between the two, and set the rod back until this comes at the stuffing-box face.

(2) Repeat with the other rod. Lift the valve covers and examine the valves.

(3) If the pump is small there is a single nut in the center of the valve, which is not a fit, the valve having lost motion or back lash. Try the valve to both ends of extreme movement; it should then uncover an equal amount of port opening. If

not, adjust to suit. I may state that in every case where I have opened up a duplex pump in a ship I find the lost motion carefully washered up.

(4) If the pump is of larger type the valve rod has double-lock nuts on either side of the valve, and I have invariably found these tight up to the valve. Lost motion must be given to the extent of 3/16 or ¼ inch, dividing the port opening equally between the extreme positions of the valve.

There is no outside lap on the slide valve of a duplex pump, and the lost motion compensates for this. Too much lost motion will cause the pistons to knock on the covers; too little shortens the stroke. Duplex vacuum pumps used for pumping hot water have lost motion visible outside the valve chest, the coupling of valve rod to its link having a connector which allows a limited amount of lost motion. The latter can be varied at pleasure by stopping the pump and adjusting the screw connector. When pumping hot water the lost motion is adjusted to suit varying temperature.

Testing of Duplex Pumps

Screw a pressure gage on the steam end and another on the water end of the pump. It will be found that there are tapped holes for the purpose in the covers.

Ascertain by the steam gage that the pump is getting full steam pressure; throttle the delivery valve on the pump until equal pressure is obtained on the water gage; open the air cock to relieve air, and steady pointers of gages by the cocks It is better to disconnect the delivery of the pump, letting the water run into the bilges, but a valve must be on the delivery of the pump. The pump should deliver full bore of water at a fair speed. Test now for low steam pressures as well as high. Satisfaction on this point having been obtained try the pump with, say, 60 pounds of steam, and throttle the delivery until the pump slows down to about eight strokes a minute. Carefully note the behavior of the gage on the water end. If the pointer remains at a reasonable constant pressure, the pump taking a full-length steady stroke as well as giving a clear exhaust cut-off, there is little or no fault.

Should, however, the gage indicate excessive ranges of pressure, with either side working with a quick return (though taking full stroke), it indicates leaky water valves as follows:

(1) Either through improper facing.

(2) A seat being loose.

(3) A valve hung up, either by fouling the side of the chamber or a foreign substance lodged between the valve and seat.

A pump working erratic and taking short strokes may be due to one of the following defects:

(1) Joints blown between the two steam cylinders, thus allowing pressure to be on the back ends of both pistons at the same time.

(2) By leaky steam pistons, allowing live steam to be on both ends of the pistons at the same time.

Either defect could be detected by throttling the delivery valve, thus slowing up the speed of the pump. The presence of live steam through the exhaust would then be plainly apparent.

Leaky water pistons or a broken joint beneath the force plate or water chamber covers will render the working of the pump erratic in some instances. But when the joint does not blow until the higher pressure is reached the gage on same would serve as an index to the trouble, it being difficult to raise the water pressure beyond a certain limit, notwithstanding the speed of the pump being increased. Under these conditions the pump would deliver but a small percentage of its plunger displacement against pressure.

The foregoing remarks on testing refer to boiler feed pumps especially, and if the test is carefully carried out will obviate the nuisance of a breakdown where a duplex pump is fitted for boiler feeding.

To test for vacuum, a vacuum gage should be fitted between a valve in the suction pipe and the pump. By adjusting the valve the vacuum gage will indicate on this point. Twenty-seven inches of vacuum should be obtained with no difficulty, and this also serves when the pump is fitted to test lightness of suction pipes. The vacuum test has, of course, its greatest value where duplex pumps are used as ballast donkey pumps and for bilges.

A. L. Haas.

London.

Bulk Cargo Steamship Frieda

There was launched on Oct. 29, from the yards of the Fore River Shipbuilding Company, at Quincy, Mass., the bulk cargo steamer *Frieda,* to the order of the Union Sulphur Company. The vessel was christened by Miss Adeline N. Snider, daughter of Mr. Clarence N. Snider, the treasurer of the Union Sulphur Company.

This vessel is 315 feet in length and of 5,000 tons deadweight on a moderate draft. The *Frieda* has been designed especially for the transport of bulk cargoes of low density, and for this reason there has been incorporated in her hull topside and also athwartship ballast tanks, making the holds self-trimming on all four sides, thereby more than doubling her ballast capacity and reducing her tonnage 20 percent.

The hull has been built to the highest class in Lloyd's Register, on what is known as modified transverse framing. The vessel is of the single deck, poop, bridge and forecastle type with propelling machinery installed aft, and is rigged with three pole masts, the fore and main having derricks and cargo discharging gear.

The accommodations comprise separate staterooms for the captain and navigating officers, together with two guests' rooms in the bridge house amidships. The engineers are quartered in a commodious Liverpool house on the poop deck, and the petty officers, seamen, wipers, etc., in wing houses at the forward end of the poop deck. These accommodations will be exceptionally comfortable and go far to establish the superiority of the quarters allotted to American seamen.

The auxiliary machinery comprises a Hyde windlass and steam capstan, Lidgerwood winches and steam steering gear with telemotor. There are a submarine signal, wireless telegraph installation, Morse night signal and a porhydrometer for the automatic weighing of the cargo.

The propelling machinery consists of a 22½-inch triple expansion engine with two large single-ended Scotch boilers with Howden's forced draft and fitted for burning liquid fuel. There have been installed in the engine room duplicate sets of 10 kilowatt generators; also two half-ton capacity ice machines to take care of the crew's consumable stores.

Altogether the vessel will prove a noteworthy addition to the owner's fleet, and it is hoped it will maintain the high tradition of her builders as exemplified in the steamship *Herman Frasch,* constructed at the Fore River Shipbuilding Company's yards at Quincy, Mass., over two years ago for the same owners.

German Naval Programme.—The new German naval construction programme provides for one battleship and one large cruiser each year from 1912 to 1917, with the addition of another battleship in 1913 and 1916.

Oil Fuel in the Navy.—During 1911 the United States navy used 15,000,000 gallons of fuel oil. The consumption for 1912 was estimated at 21,000,000 gallons.

Review of Important Marine Articles in the Engineering Press

H. M. Torpedo Boat Destroyer Lurcher.—The *Lurcher,* one of the *Firedrake* type, obtained during an official full-speed trial of eight hours a mean speed of 35.345 knots, or 3.345 knots in excess of the contract speed. The trial was run in deep water. The boat is 255 feet long with a beam of 25 feet 7 inches, and is propelled by twin screws driven by Parsons turbines, steam being supplied by three of the latest type of Yarrow boilers arranged for burning oil fuel only. Illustrated. 250 words.—*Engineering,* September 27.

The Diesel-Engined Ship Fordoman.—The motor ship *Fordoman,* of 2,368 gross tons, 250 feet long by 42 feet 6 inches beam by 26 feet 6 inches depth, has been built by the Clyde Engineering & Shipbuilding Company, Port Glasgow, for the grain-carrying trade on the Canadian Great Lakes. The propelling machinery consists of a four-cylinder set of Carels two-stroke-cycle Diesel engines, with cylinder diameters 18⅛ inches and stroke 32¼ inches, designed to develop 750 brake-horsepower at a normal speed of 120 revolutions per minute. On trial the designed speed of 10 knots was exceeded, the fuel consumption being .47 pound per brake-horsepower per hour throughout. Exceptional results were also obtained in maneuvering, as 63 reversals were accomplished in 42 minutes, and at the end of the trial more than half of the stored compressed air was still available. A complete reversal from full speed ahead to full speed astern occupied six seconds, and the engines were stopped dead from full speed in three revolutions. 250 words.—*Engineering,* September 27.

Deckloads of Lumber.—By Arthur R. Liddell. The fallacy of the British law regarding deckloads of lumber is pointed out, and in a discussion of the sea-going qualities of a lumber steamer loaded with a deckload, the proper disposal of deck cargo for safety in ships of different design is explained. 1,700 words.—*The Marine Review,* October.

Submarine Torpedo Boat Seal.—The *Seal* is the first submarine of her type to be built for the United States navy. She was constructed by the Lake Torpedo Boat Company, Bridgeport, Conn., and recently completed her acceptance trials off Provincetown, Mass. The arrangement of torpedoes in this boat is unique. Besides the ordinary bow tubes there are also deck torpedoes carried in revolving torpedo tubes in a superstructure, so that they may be trained to either broadside as any ships' guns. In her trials the boat made a surface speed of 14.7 knots and a submerged speed of nearly 11 knots. She was submerged to a depth of 256 feet with the crew on board, which is a record in the performance of submarines. One photograph. 700 words.—*The Marine Review,* October.

The Commercial Prospects of the Marine Oil Engine.—It is pointed out in this editorial discussion that while there is every promise of the mechanical success of the marine oil engine, the problem as a commercial one is more complex. The remarks of Sir Charles Parsons, in his presidential address delivered to the Northeast Coast Institution of Engineers and Shipbuilders recently, are commented upon freely, as his address was a masterly survey of contemporaneous progress towards economy in marine propulsion. According to the information presented in this way it is evident that by no possibility could oil displace coal for all purposes, and that if there is not a great development in the output of oil the progress of the marine oil engine must suffer. A comparison of the relative costs of different fuels, as supplied by Mr. C. E. Stromeyer in his annual report as chief engineer of the Manchester Steam Users' Association, is also quoted, showing that at $3.60 (15s.) per ton for coal, oil would have to be at $12.50 (50s.) for equality. The disadvantages of oil engines, apart from the cost of fuel, were also discussed, as well as the possible increase of efficiency of marine steam machinery. While the possibilities of a gas turbine are not counted as particularly hopeful by Sir Charles Parsons, yet the possibility of a semi-rotary engine in its place is set forth for a future development of internal-combustion engines. 2,500 words.—*Engineering,* November 1.

Developments in Battleship Design.—The various stages of development of battleship design in the British navy from the *Dreadnought* to the *Iron Duke* and *Marlborough* (recently launched) are traced. Little is known regarding the details of the last two vessels except that they are 580 feet long, 90 feet beam, with a displacement of 25,000 tons. The primary armament consists of ten 13.5-inch guns, the position of the guns in the ship corresponding generally with that evolved for the *Orion.* The secondary battery in these vessels consists of 6-inch guns mounted behind broadside armor on each side of the ship. The extent of the armor protection has not been disclosed, but undoubtedly it is increased both in thickness and extent over that in previous battleships. The speed of the new vessels remains at 21 knots, power being developed on four shafts from turbine engines operating at about 300 to 320 revolutions per minute. The power is increased from 23,000 in the *Dreadnought* to 29,000 in the new ships. Thus while the tonnage has increased by 40 percent the designed horsepower has increased only by 20 percent. 1,250 words.—*Engineering,* October 11.

German Motor Notes.—From observations made on a visit to the principal marine engine builders in Germany it was found that in that country there are seven firms which are actually building heavy oil marine motors of considerable size. These firms are Blohm & Voss, Hamburg; The Reiherstieg Shipbuilding Company, Hamburg; Fried Krupp, Kiel; A. G. "Weser," Bremen; J. C. Tecklenborg A. G., Geestemünde; J. Frerichs & Company A. G., Osterholz-Scharmbeck, and the Maschinenfabrik Augsberg Nuremberg, Nuremberg. Of the firms mentioned, Maschinenfabrik Augsberg Nuremberg and Krupp already have engines at work on submarines and for small craft. Frerichs also have installed engines on some small fishing craft. The others are not as yet represented afloat, although progress on work in the shops in building motors of large units is well advanced. Generally speaking, all these engines are the outcome of considerable experience on a smaller scale. All firms are building two-cycle engines. Reiherstieg and Tecklenborg are building motors after Carels designs. Krupp and Blohm & Voss are working with Maschinenfabrik Augsberg Nuremberg, while the Weser and Frerichs companies are working on quite a different line, building engines according to Professor Junker's patterns. The most remarkable feature noted in this trip was the progress made with the double-acting engine and the use of tar oil as fuel. The one point upon which unanimity has apparently been reached is in the general design. In all cases it was found that for the larger engines the trunk piston has been abandoned in favor of the cross-head and piston rod, while the entirely open engine is finding increasing favor. In general, the construction of oil motors is being taken up by marine steam engine builders, and the results of many years' sea-going experience has an important influence in the design. The use of compressed air for starting and maneuvering motors seems to be the only available means for this purpose. The driving of auxiliaries is still unsettled. There is also no settled policy with regard to the driving of the scavenging pumps. The general impression recorded from these observa-

tions is that the mechanical aspect of the provision of oil engines suitable for adoption on ships of the type of which some four-fifths of the German steamers of the world consists is to-day a matter of practical politics. Two difficulties only stand in the way: First, the necessary number of engines could not at present be produced from the factories of the world, and, second, a regular supply of fuel at a reasonably cheap rate, say not more than three times the cost of coal, is not yet assured. The notes describe in detail the construction of the different engines inspected, and the notes are profusely illustrated with photographs and line drawings. 14 illustrations. 8,000 words.—*The Engineer,* October 11 and 18.

The Strength of Bulkheads.—The scantlings suitable for a bulkhead depend upon the purpose for which it is fitted. Two cases are considered: First, the end bulkheads of spaces which are to contain water ballast or oil, and, second, the "ordinary" watertight bulkheads which only have to withstand water pressure in case a compartment is accidentally flooded. The first bulkhead is much more rigidly stiffened, while in the second bulkhead the scantlings are much lighter, and the bulkhead does not necessarily prevent considerable deflection or a certain amount of leakage which can be taken care of in an adjacent compartment by the ship's pumps. It is found to be more economical as regards weight of material involved to fit brackets and small-sized stiffeners rather than larger stiffeners with no brackets, and it is now the general practice to fit brackets at the top and bottom of stiffeners at least in the holds and lower 'tween decks. The theoretical treatment of the strength of bulkhead plating is a difficult matter, but the most reliable formulæ for such calculations are thoroughly discussed. A design for "ordinary" bulkheads is proposed, in which the stiffening is furnished on the principle of the more rigid oil-tight bulkheads. It is found that such construction would be more expensive to construct, and would tend to break certain stowage rather more than the arrangement of uniform stiffeners, although it is obvious that if the strengthening of bulkheads is to be increased beyond present practice some sacrifices must be made. 4 illustrations. 2,800 words.—*The Shipbuilder,* November.

Cargo Steamers for Service on the St. Lawrence and Great Lakes of North America.—The size of locks in the canals between Montreal and the Great Lakes necessarily limits the dimensions of the vessels which pass through, consequently a special type of boat, abnormally broad in relation to the length, has been evolved for cargo-carrying on this route. The greatest dimensions which can be conveniently maneuvered through the locks are: Length over all, 259 feet; breadth, extreme, 43 feet 6 inches; draft, 14 feet. The chief features of the design of such vessels are indicated by drawings and the important points in their design are fully treated. It is noted that the use of internal-combustion engines for the propulsion of such vessels has already been tried, offering distinct advantages as regards increased deadweight and cubic capacity. Their future adoption for this service will depend upon their reliability under service conditions. 6 illustrations. 1,200 words.—*The Shipbuilder,* November.

The French Liner Paul Lecat.—This vessel is a twin-screw liner recently completed at La Ciotat for the Compagnie des Messageries Maritimes mail service between Marseilles and China and Japan. She has a length over all of 528 feet, a breadth of 61 feet 9 inches, a displacement, loaded, of 15,100 tons, a draft, loaded, of 24 feet 4 inches, and a designed sea speed of 15 knots. Her gross tonnage is 12,988. Accommodations are provided for 149 first class, 182 second class and 109 third class passengers. Propulsion is by two quadruple expansion engines developing 11,000 indicated horsepower, with cylinders 30½, 43, 62½ and 88½ inches diameter, with a stroke of 53 inches. Steam at 215 pounds pressure is furnished by twelve cylindrical double-ended boilers fitted with Howden's system of forced draft. The total heating surface is 29,000 square feet. The bunkers have a capacity of 1,850 tons. The electrical installation comprises four generating units having a total horsepower of 500. The ship attained a main speed of 17.245 knots on a 40-hour trial, developing only about 10,300 indicated horsepower. A sister ship, to be named the *André Lebon,* for the same service, is now in course of construction at the La Ciotat shipyard. 12 illustrations. 1,000 words.—*The Shipbuilder,* November.

Burbridge Patent Double Davits.—This davit consists of an ordinary round-bar ship's davit with a smaller one attached to it through means of two heavy forged collars. This arrangement permits one set of davits to handle two lifeboats. The upper boat is always suspended from the ordinary davits ready for immediate launching, but before putting it outboard the small davits attached thereto are swung around over the second boat, and the attachment of the second boat to the small davits is carried out while the upper boat is being lowered into the water. No gears are used, but the leverage of one davit swings out the other. 3 illustrations. 800 words.—*The Steamship,* November.

Presidential Address.—By Mr. Summers Hunter. At the October meeting of the Institute of Marine Engineers, Mr. Hunter delivered a lengthy presidential address, discussing first the history of marine steam engineering and then taking up in detail the many developments which have been made recently in ship propulsion. No attempt is made to describe the various types of propulsive machinery, but the results accomplished and the advantages gained in each case are indicated. The internal-combustion engine and the various forms of transmission are treated briefly, as work in this direction is still largely in an experimental stage. Considerable attention is given to the subject of superheating, in which it is pointed out that the ordinary saving derived from the use of superheated steam appears to be 20 percent. Further economy has recently been effected by using superheated steam in quadruple-expansion engines. Other sources of economy have been found by the use of improved air pumps, a better knowledge of the principles of condensation, vacuum, feed-water heating, etc. The success of the Diesel oil engine is treated quite fully, the speaker emphasizing the fact that before this prime mover is extensively adopted further results must be obtained from the actual behavior of the engines as installed in ships under the most severe conditions at sea. The address is concluded by reference to recent improvements in methods of manufacture and the education and training of engineers in the future. 7,500 words.—*Transactions of the Institute of Marine Engineers,* October.

The Spanish Battleship España.—Three battleships, the *España, Alfonso XIII.* and *Jaime I.,* are now under construction in Spain under the direction of the Vickers-Elswick Syndicate. The displacement of the ships is 15,700 tons, the length on waterline, 439½ feet; beam, 78¾ feet, and mean draft, 26 feet. The armament consists of eight 12-inch 50-caliber guns in four twin turrets, and twenty 4-inch guns with four smaller pieces and three submerged torpedo tubes. The big guns are distributed as on the British battle cruiser *Indomitable;* their height above the water is 25 feet, and they are protected by 10-inch armor. The belt armor is 8 inches thick, tapering to 4 inches at the ends. The propelling machinery consists of four sets of Parsons turbines, actuating four screws, the horsepower being 15,500 and the designed speed 19.5 knots. Yarrow boilers are installed, the coal bunker capacity being 900 tons normal and 1,900 tons maximum. 2 illustrations. 1,600 words.—*The Marine Engineer and Naval Architect,* November.

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., of INTERNATIONAL MARINE ENGINEERING, published monthly at New York, required by the act of August 24, 1912.

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H. L. Aldrich, President and Treasurer.

Sworn to and subscribed before me this 2d day of October, 1912.
(Seal) DAVID FISCHER,
Notary Public.
(My commission expires March 30, 1913.)

The regulations of the Treasury Department promulgated under the provisions of Section 5 of the Panama Canal Act relating to the free entry of shipbuilding materials and equipment have just been completed, and will soon be available in printed form to those interested. The following is a memorandum of the principal features of these regulations:

1. A vessel will be defined as any water craft entitled to be documented under the laws of the United States and similar craft for which there are no such requirements, such as battleships, revenue cutters and governmental vessels. This will include every vessel of over 5 tons, whether used by the Government or for commerce or pleasure.

2. Machinery will not be entitled to free entry. Included in the term "machinery" will be auxiliary machinery, such as pumps, steam winches, hoisting engines, electric motors, and generators, condensers, etc.

3. The term "outfit and equipment" will be defined as including all portable articles not permanently incorporated in the hull or machinery, and will include rigging, tackle, boats, life-saving apparatus, wireless apparatus, searchlights, lamps, bedding, furniture, tableware, small arms, etc., but will not include consumable supplies, such as coal, food, medicines, etc.

4. The term "outfit and equipment" will also be held to include, not only the original outfitting and equipping, but also renewals and replacements.

5. Materials will be defined as including merchandise suitable for use in the construction or repair of a vessel or its machinery to be incorporated therein after having undergone a process of manufacture subsequent to importation, or in its condition as imported, provided it has been purchased in the open market and was not constructed or fabricated on a special order or after a special design. This will include raw materials, such as pig-iron and lumber, rough forgings and castings, but not finished ones, nuts, screws, bolts, steel plates, ships'-knees, floorings, etc., and other things which, though completed articles, are useful as parts in the construction or something else.

6. The word "articles" is defined as including only such articles as are suitable for use in their condition as imported in the outfit and equipment of a vessel; but such articles may be fitted, polished, painted, or otherwise improved in condition, or fixed in place subsequently.

7. Shipbuilding materials may be entered for warehouse and withdrawn, as desired, within three years from date of importation free of duty upon compliance with the regulations.

8. The regulations provide that materials may be made or manufactured in a custom district other than in which entry is made, and provisions are also made for the disposition of unused portions of importations.

9. Merchandise entered under this act is required to be appraised and classified, but the liquidation of the entry will be suspended pending the production of evidence of compliance with the regulations.

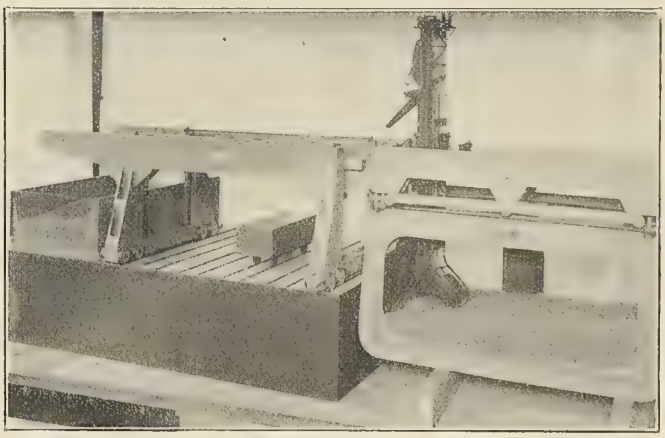
10. Various forms of applications, bonds and affidavits, to show the disposition made of the merchandise, are provided.

11. The regulations further provide that, subject to compliance with the regulations, liquidated entries of merchandise imported on or after August 24, 1912, may be reliquidated free of duty where the liquidation has not become final, and that free entry will be granted to merchandise entered in bond on or after that date for which no permit of delivery has been issued.

Improved Engineering Specialties for the Marine Field

A New Vessel Unloading Machine

The transportation of iron ore and coal on the ocean has been a serious problem, owing to the meager facilities for unloading and the impracticability of installing machinery for unloading vessels similar to that on the Great Lakes on account of the immense investment for special docks and equipment which could be used only intermittently. To overcome this difficulty, ocean-going vessels have been built with false bottoms which are raised on the sides by hydraulic machinery for the purpose of running the load to the center of the ship, from which it is carried out by conveyors; some with bins on the inner side of the hull with a crane for each bin, and many others of different types, all being expensive in first cost, operation and maintenance, although they are an improvement over the old methods which still obtain in some



parts of the world. The latest colliers in the navies of the several powers still leave very much room for economy in cost and in the rate of delivery in bunkering.

To cope with the problem of unloading vessels a new machine devised by Mr. F. H. Kindl has been placed on the market by the Kindl Vessel Unloading Company of Pittsburg, Pa. The general character of the machine can be understood from the view of a model shown herewith. It has a loose scoop bucket, working in an elevator shaft, and may be placed on a crane girder and carried by a vessel, or it may be transferred to a bridge on a dock in a very few minutes. The bucket is watertight, so grain or liquids could be discharged in a pinch, although it would not be so economical for these purposes as a pneumatic machine or a pump. The bucket being removable, a platform could be substituted for hoisting miscellaneous cargo within certain limitations. This feature also facilitates repairs, as the bucket is the only part of the machine which has any considerable wear.

The machine has a wide range of adaptability, as it will handle ore, coal, coke, limestone, gravel, sand, etc., and can be used for ditching and similar purposes. Its capacity can be made to suit many different requirements. The filling of the bucket being a shoveling action under the complete control of the operator, it is necessarily less degrading to such material as coal than the well-known action of the grab bucket. It is claimed to be the only machine which will discharge to cars or a stock pile and successfully transfer the material from stock to cars or vessels without auxiliary hoisting devices.

The weight of the machine and crane girder as designed to be carried by a vessel is approximately 50 tons, which is a very small dead weight when compared with the weight of steel for bins and cranes on the European ore and fuel vessels and the special construction and machinery for the recent colliers in this country.

The Kindl machine can be built with a discharging capacity of 500 tons of coal per hour, and a floating coal storage could be equipped with four machines to bunker coal in two steamers in calm weather simultaneously, two machines working on each ship. The loose bucket weighing approximately two tons, making about four trips per minute, and each machine requiring not more than two men, the cost of operation is infinitesimal when compared with other devices.

Fire Underwriters Make Interesting Test of J-M Pure Cork Sheets

J-M pure cork sheets, manufactured by the H. W. Johns-Manville Company, New York, as shown in the accompanying illustration, were recently tested by the Underwriters' Laboratories, under the direction of the National Board of Fire Underwriters, Chicago, to discover the resistance of the material to destruction by fire under conditions fully as severe as could possibly be expected in actual service. For this purpose a section of 3-inch hard-baked hollow tile wall was built in a steel frame prepared for this purpose, about 10 feet high by 8 feet wide. On this tile there were erected in Portland cement mortar, with joints broken, two courses of J-M pure cork sheets, each 2 inches thick and finished with ½-inch Portland cement, troweled smooth. The panel was twelve days old at the time the test was made. The method of testing consisted of exposing the panel to the attack of a soft, rolling gas flame for one hour with temperatures rising to 2000 degrees F. The furnace was controlled so that the temperatures rose uniformly throughout the test, the maximum temperature being reached at the 60-minute period. At the starting of the test the temperature of the wall section or panel was about 62 degrees F., and at its close the thermometers imbedded in the cork registered an average of 72½ degrees F., while those at the inner edge of the surface of the tile wall averaged about 3 degrees F. lower. It was impossible to tell by the touch at the close of the test on the back of the

tile wall that there was any excess heat on the other side of it, and yet the gas flames had been directed upon the other side for an hour. Directly following the fire treatment, and while the surface of the panel was still in a highly heated condition, a stream of water was applied to the heated surface. It was applied for five minutes through a ⅞-inch nozzle, set 20 feet from the panel, and at a pressure of 60 pounds per square inch measured at the base of the nozzle. The result of the exposure to the gas flames for an hour, followed by the application of the hose stream for five minutes, was to calcine and destroy the outer coating of plaster, and to carbonize and partially destroy the outer layer of 2-inch cork sheets, but the transmission of heat through the carbonized cork layer had

been so slow that the cement coating between the two courses of cork was practically uninjured, the under course of cork remaining intact. The tile wall was in perfect condition, and consequently it was concluded that the properties of the insulating material and its method of construction warrant its approval for use in the insulation of refrigerated structures.

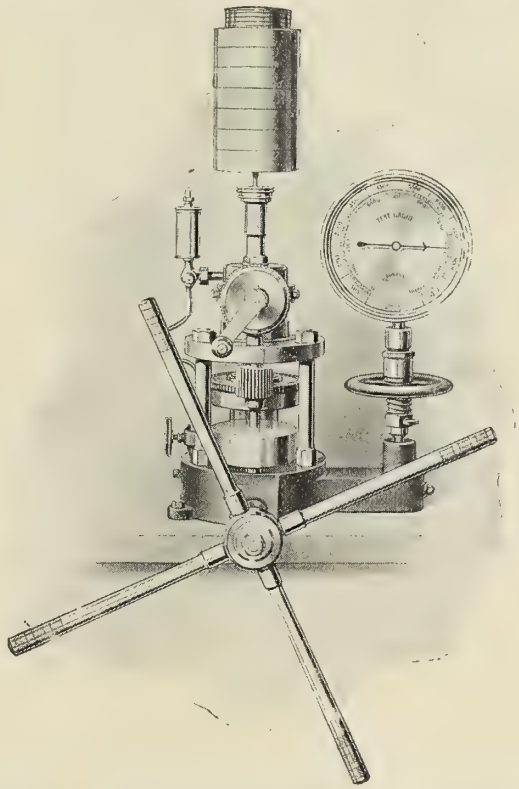
Dallett Pneumatic Wood Carving Tools

Thomas H. Dallett Company, Philadelphia, Pa., has placed on the market a pneumatic wood-carving tool which is useful for any branch of woodworking industry where gouging,

roughing or carving is done, as, for instance, in pattern making. The use of the pneumatic tool is claimed to accomplish the work more quickly and more satisfactorily than by hand. The tool is made in two sizes—a ¾-inch for finishing work and fine carving, and 1-inch, or "Fingergrip," for gouging and heavy roughing work. Each size can be regulated to give the lightest or hardest blow of the piston, according to the operator's wishes, either by placing the thumb over the exhaust hole or cutting down the air supply by means of the stop cock in the hose. Both tools are of the valveless type, the piston is the only moving part, and strikes as many as 2,000 and 3,000 blows per minute according to the pressure carried. A bushing, inserted in the lower end of the barrel, is made for the reception of a shank quarter octagon in shape instead of round, so that the chisel can be held steadily or twisted as desired. The air consumption of the ¾-inch tool is approximately 4 cubic feet of free air per minute and that of the 1-inch "Fingergrip" about 5 cubic feet, the air pressure commonly used being between 70 and 90 pounds per square inch.

The American Multipar Hydraulic Deadweight Tester

The American Steam Gauge & Valve Manufacturing Company, Boston, Mass., has placed on the market a hydraulic deadweight tester where each 10-ounce weight will positively calibrate from 1 pound to 100 pounds pressure per square inch, and a 6¼-pound weight will as accurately calibrate from 100 to 1,000 pounds pressure per square inch. Multiples of these deadweights make its usefulness practically unlimited, it being as simple to calibrate a 25,000-pound gage as one of 5 pounds. This extraordinary range is secured by means of a very simple system of multiple pistons, all of which are fixed and permanent, the third, or top cylinder, having two interchangeable pistons, the larger being used for pressures from 1 to 100 pounds per square inch, the smaller for from 10 pounds to whatever pressure is desired, the outfit as regularly supplied being equipped up to 25,000 pounds per square inch. In operating, a pressure is created by applying weights to the piston in the upper cylinder. This gives a pressure which acts precisely as would weights if applied to the end of the lower piston. It is by means of this upper cylinder that

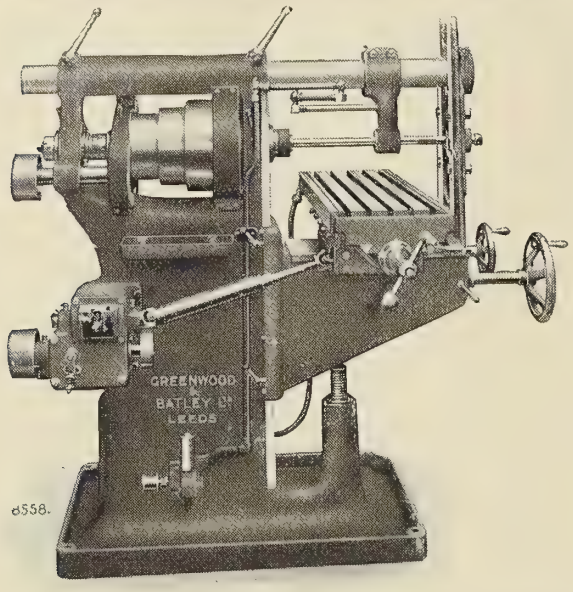


the heretofore insurmountable difficulty of securing great pressure by the use of light weights has been overcome. Low-pressure tests are made by opening a by-pass connecting the upper and lower cylinders, which allows the pressure created by the pressure screw in the lower chamber to connect directly both with the upper chamber and with the gage being tested. The system is thus converted into the original direct deadweight tester.

Horizontal Milling Machine

Greenwood & Batley, Ltd., Leeds., exhibited at the Olympia Engineering and Machinery Exhibition, 1912, a horizontal milling machine which has been completely redesigned, and is now equipped with the most modern and essential features of a high-grade heavy-duty milling machine, specially adapted for general manufacturing work. This machine has a longitudinal automatic feed of 28 inches, a cross adjustment of 11 inches, and a vertical adjustment of 20 inches. It is built both with and without reversing gear to the automatic feed, and is equipped with feed change gear box, solid top knee, arm brace, graduated index disks to all movements, back gears and a two-speed countershaft. A special feature of the design is the absence of complicated mechanism which, while increasing the cost of the machine, has no practical value in a machine intended for manufacturing work. The twelve spindle speeds rise in geometrical progression from 18.5 to 650 revolutions per minute. The end thrust of the spindle is taken by hardened ball-thrust bearing, and any necessary compensation for wear can be made by adjusting nuts at the rear of the spindle. The vertical adjustment of the solid top knee is by a telescopic elevating screw, operated by the larger of the two hand-wheels in front of the machine, and a graduated

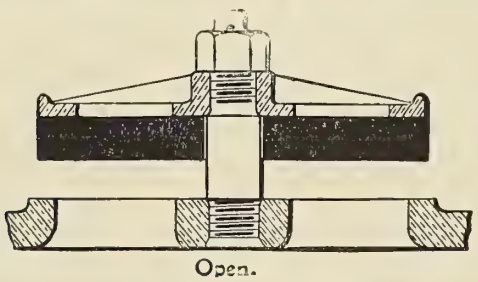
index disk, reading in thousandths of an inch, is fitted to the elevating shaft. The working surface of the table is 44 inches by 14 inches, which is larger than is usual on machines of this capacity. Power feed is provided for the traverse of the table in the longitudinal direction. The automatic speed is driven from the spindle through a change-speed gear box, any one



of eight rates of feed to each speed of the spindle being available by the movement of levers on the front of the feed-gear box.

"Dexine"

"Dexine" is the name and registered trademark of a patent compound of which the owners and sole manufacturers are the Dexine Patent Packing & Rubber Company, Ltd., Abbey Lane, Stratford, London, E. This compound was discovered about sixteen years ago after years of experiment and research, and is, briefly, a composition of vulcanized india rubber and other ingredients manipulated by a special process, the resulting material being of an exceedingly tough and frictionless nature, capable of withstanding extreme temperatures and quite impervious to the deleterious action of acids,



Open.

oils, gases, ammonia and grease. The many uses of this material were shown at the Olympia Engineering and Machinery Exhibition by the manufacturers. Steam users will be interested to know that this material has formed an efficient means of making tight joints for manholes and mud holes in boilers. Since oil fuel has been adopted by many steam users, "Dexine" has also been found useful for the joints of deck plates, tanks and numerous joints required where oil fuel is burned. The material is particularly adapted for use as pump buckets. In this case the plunger is made in two parts, on which the "Dexine" buckets are fitted back to back with an intermediate ring between, serving as an effectual support to the shoulders on the double stroke. "Dexine" is also widely used for conical gage-glass rings, and also for inadhesive packing rings for packing metal rods as well as glass tubes. "Dexine" valves, round, rectangular, disk or flap for air, circulating or straight-lift pumps, are now very largely used, and have proved to be much more valuable than ordinary india rubber. The type of valve for such purposes is shown in the illustration.

A Boiler Scale Remedy

The United States Graphite Company, Saginaw, Mich., have on the market a boiler graphite made from the product of mines in Mexico which is claimed to be a sure and safe boiler scale remedy. Owing to the unequal expansion and contraction of the metal of a boiler, and the scale in it, the latter during alternating periods of heating and cooling becomes more or less cracked, and on account of these small cracks pure graphite, suitably prepared and circulating with the water, finds its way through these minute openings, and deposits itself on the inner surface of the tubes and shell between the metal and the scale, with the result that the latter will no longer adhere tenaciously and may be removed with comparative ease. Continued use of this graphite after the boilers have once been cleaned prevents the subsequent accumulation of hard scale. The use of this remedy has the advantage that it does its work without doing any harm to the boiler itself, since its action is mechanical instead of chemical.

Obituary

LORD CHRISTOPHER FURNESS, First Baron of Grantley and the head of the Furness Steamship Line and of Furness, Withy & Company, died Nov. 10 in London. Lord Furness was born in West Hartlepool, April 23, 1852. From 1891 to 1895, and again from 1900 to 1910, he was a Liberal member of Parliament from Hartlepool. Among the enterprises in which Lord Furness was heavily interested was the Cargo Fleet Iron Company. In 1897 he effected a consolidation of the British Maritime Trust and the Chesapeake & Ohio Steamship Company, of which lines he was president.

CLEMENT A. GRISCOM, one of the founders and the first president of the Society of Naval Architects and Marine Engineers, and an honorary member of the Institution of Naval Architects, died suddenly at his home in Haverford, Pa., Nov. 10. Mr. Griscom was born in Philadelphia, March 15, 1841, and received his education at the Friends' Central High School. At sixteen he was graduated and obtained a clerkship in the old, conservative shipping house of Peter Wright & Son, of which he became a partner as soon as he attained his majority. Mr. Griscom began the operation of the old American Line in 1871 with the only steamers then flying the American flag in the North Atlantic. From this beginning he brought together under one management the greatest steamship combination in the world, which reaches all the principal ports of the North Atlantic. Mr. Griscom was successively vice-president and president of the International Navigation Company, which he organized, and in 1892, with the co-operation of J. Pierpont Morgan, he merged it into the International Mercantile Marine Company, of which he was president until 1904 and chairman of the board of directors until three years ago.

CLEMENT MACKROW, manager of the shipbuilding department and naval architect of the Thames Iron Works & Shipbuilding Company, Ltd., was accidentally killed Sept. 23. Mr. Mackrow's entire business career was spent in the Thames Iron Works Company, where, entering the business at an early age, he followed in the footsteps of his father, being employed first in the drawing office and then passing successively through the various other departments of the works, devoting his entire career to the construction of first-class ships. Mr. Mackrow was a member of the Institution of Naval Architects, and was lecturer on naval architecture at the Bow and Bromley Institute. He has long been well known in the marine field as the

author of "Naval Architect's, Shipbuilder's and Marine Engineer's Pocketbook."

Samuel A. Cramp, a son of William Cramp, founder of the Cramp Ship & Engine Building Company, died, Nov. 3, at his home in Philadelphia, aged 79 years. At the time the Cramp interests were sold to the present owners in 1896, Mr. Cramp was president of the Company. He had begun his career, like his brothers, as an apprentice, and had worked his way up step by step into an executive position.

Gustav H. Schwab, head of the firm of Oelrichs & Company, general agents for the North German Lloyd Steamship Company, died at Litchfield, Conn., Nov. 12. Mr. Schwab was born in New York in 1851. He received his early education from a private tutor, and in his fourteenth year he was sent to the Gymnasium at Stuttgart, Germany. He entered the mercantile profession in his eighteenth year in Bremen in the employ of H. H. Meier & Company. In 1873 he returned to New York, and entered the office of his father's firm, Oelrichs & Company, and took charge of the agency of the North German Lloyd. On July 1, 1876, he became a member of the firm of Oelrichs & Company, and continued in the active management of the firm's affairs until his death. Mr. Schwab was closely associated with a great number of important financial institutions and had an important part in many public affairs.

Technical Publication

Fighting Ships. Fifteenth Edition. Edited by Fred. T. Jane. Size, 12½ by 7½ inches. Pages, 546. Numerous illustrations. London, E. C., 1912: Sampson Low, Marston & Company, Ltd. Price, 21/– net.

The principal innovation of this year's "Fighting Ships," as stated in the preface, is that owing to the courtesy of the various Admiralties concerned the proofs of most of the ship pages have been officially revised. This has led to the non-publication of certain more or less speculative plans of new ships, building or projected, which can be considered only as "intelligent anticipations" rather than accurate data. As is usual, photographs of new ships have been obtained where possible, and the system of replacing those of old ships by modern photographs wherever any small change in the appearance of the ship has been made has been adhered to.

As is well known, the main particulars of all of the naval vessels of practically every naval power in the world are tabulated in this book, each navy being taken up in the order of its strength. The information is presented as briefly as possible in tabular form, a separate page being devoted to each of the vessels, or class of vessels when there are several built according to the same design, together with photographs of the ships, and drawings showing the disposition of armor and armament. The dates of laying down and completion, with data from the trials, are given in each case, together with general notes summing up the special features of the vessel or vessels described. The order of the great naval powers in the present volume is: First, British; second, German; third, United States; fourth, Japanese; fifth, French; sixth, Italian; seventh, Austro-Hungaria, and eighth, Russian.

The second part of the book contains two interesting articles, the first by Mr. C. de Grave Sells, on the "Progress of Warship Engineering," and the second by General Cuniberti, chief constructor of the Italian navy, on the "Battleship of the Future."

The first article is practically a review of the information which has been published during the past year in the engineering press regarding the development of naval engineering. As the present year is the one hundredth anniversary of the commencement of British steam navigation, the details of the *Comet,* the first commercial steamboat operated in Great Britain, are contrasted with the features of the latest British warships such as the *Lion,* showing the wonderful development which has taken place in shipbuilding in the first century of steam navigation. In discussing the present tendencies of propulsive machinery for war vessels the relative advantages or disadvantages of turbine and reciprocating-engine drive are compared by describing the trials of the two Italian battleships *San Giorgio* and *San Marco,* two sister ships, the former having reciprocating engines and the latter turbine machinery. The results of these trials, the author states, are considered to demonstrate the unquestioned superiority of the turbine over the reciprocating vessel in this class of vessel. He then gives data obtained from the trials of several United States destroyers which were equipped with different types of turbines. Following this is a description of the results obtained with different types of reduction gear, including mechanical, hydraulic and electrical transmission. Other subjects considered are the erosion of high-speed screw propellers, the corrosion of condenser tubes, superheating, and the recent developments in auxiliary machinery and machine tools.

The last part of this article is devoted entirely to the question of motor ships and internal-combustion engines. No attempt is made to describe in detail all of the different types of Diesel engines which have been adapted to marine work, but the principal installations which have been made during the past year are described and the advantages of this type of propulsion are discussed. Although he emphasizes the fact that there are serious disadvantages to be overcome in the use of internal-combustion engines for large ships he does not enumerate the disadvantages as fully as might be expected. In conclusion, he states that it is certain that another line of progress will be a further substitution of oil for coal, either for the generation of steam or for the direct use in the cylinders, although to what extent will largely depend upon the amount of production of the oil fields and the action of those who control the supply.

The second article in Part II. is of special interest, both because of the high esteem in which the author, General Cuniberti, is held in the naval world, and because of the importance of the subject. The present tendencies of battleship design point out that the future ship will be of the "all-big-gun" class. What is looked for in the development of the gun is that a desirable weapon shall be developed to be capable of long service and of always retaining its original precision of fire, the arrangement of the armament probably being worked out, as was first done in the United States navy, by placing all of the guns on the center line of the ship with the turrets on different levels, the exact position of the guns, of course, further depending upon the grouping of boilers and funnels and the installation of the magazines. Another development which must be looked for in connection with the improvement of the range and accuracy of torpedoes, is more adequate under-water defense of the battleship against torpedo attack. The tendency in the matter of armor indicates that the extensive but deficient protection of to-day is about to undergo a serious evolution, making way for a less extensive but much heavier armor—possibly 16 inches thick—capable of providing ample protection to the vital parts of the ship. The increase of armor, however, is directly opposed to the present tendency of increasing speed, since an increase of speed, if the heavier armor is retained, means a larger displacement, and therefore a greater area to be protected. Apparently, General Cuniberti believes that the tendency to sacrifice armor protection for speed is a step in the wrong direction, as in that case only the waterline and gun stations are partially protected, whereas what is required is an actual citadel absolutely secure and impenetrable from the large shell of the future, and which after many hours of combat may still be intact and render its full efficiency, thoroughly protecting all vital functions of the vessel and particularly maintaining the reserve buoyancy and reserve forces.

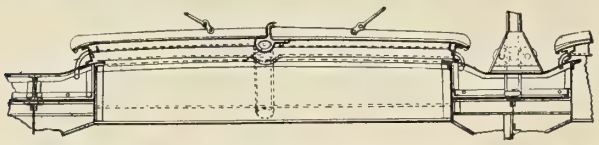
Selected Marine Patents

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

1,028,263. SHIP'S HATCHES AND DECKS. JOSEPH R. OLDHAM, OF CLEVELAND, OHIO.

Claim 3.—In ship construction, the combination of a pair, or pairs, of metal hatches with inner-adjoining-margins upwardly flanged, one flange of each pair of hatches having a slight projection adapted to cover the joint of said upwardly turned margins, the fellow hatch margin being constructed with a gutter below said flanges adapted to receive any leakage between said margins and to convey the water into drain pipes



leading from around super-coamings, into wing ballast tanks or deck chambers between hatchways; outer margins of hatches downwardly curved and adapted to be seated on outwardly inclined or beveled supercoamings, said hatches being fitted with hinges attached to a platform deck to facilitate the raising and lowering of hatches when actuated by tackles. Eleven claims.

1,028,387. SUCTION DREDGER. ERASTUS E. ROBERSON, OF LE GRAND, CAL., ASSIGNOR OF TWO-THIRDS TO WILLIAM A. HUELSDONK, OF LE GRAND, CAL.

Claim 1.—A dredger comprising two floats spaced apart, a conveyor pivotally mounted between said floats, a frame hinged to each of said floats and spaced apart, an independent auxiliary float on the outer end of each of said frames, and means connecting said conveyor to said frames. Three claims.

1,028,473. TORPEDO BOAT. HUDSON MAXIM, OF HOPATCONG BOROUGH, N. J.

Claim 1.—In a torpedo boat, the combination of the hull of the boat, a dispensable bow portion or compartment, an explosive charge in the

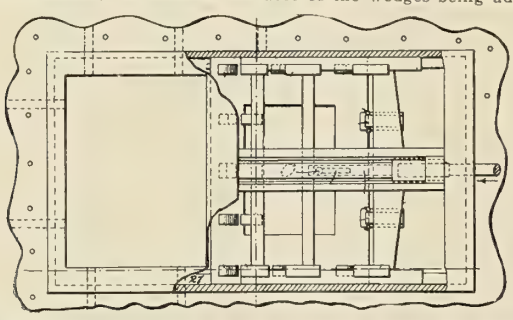
forward end thereof, and a tamping material in said bow portion between said explosive charge and the bow of the torpedo boat proper. Fifteen claims.

1,028,897. MARINE CABLEWAY. THOMAS SPENCER MILLER, OF SOUTH ORANGE, N. J.

Claim 1.—In a cableway, the combination with a drum, of a fluid pressure operated engine therefor, a cable under tension actuated by said drum, and means automatically acting in accordance with the degree of tension of the cable for increasing the fluid pressure of the engine when the tension on the cable is reduced and for decreasing such fluid pressure when the tension on the cable increases. Thirty-nine claims.

1,029,620. DOOR, HATCH, OR LIKE CLOSING DEVICE. GIUSEPPE MAZZOLINI, OF NAPLES, ITALY.

Claim 3.—In a combination, a door frame, a sliding door associated therewith and provided with recesses having inclined surfaces, a frame movably connected to said door and provided with wedges adapted to enter said recesses, the inclined surfaces of the wedges being adapted to



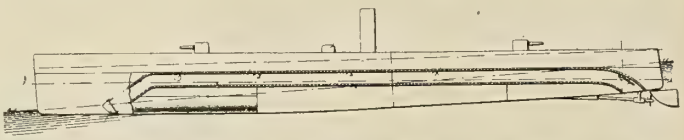
engage the inclined surfaces of the recesses, means for moving said frame to move said door into registry with the door frame and means for arresting the movement of the door, whereby movement of said frame relatively to said door, will cause the inclined surfaces of the wedges to slide along the inclined surfaces of the recesses, thereby forcing the door to move in a direction substantially at right angles to its first direction of movement. Four claims.

1,029,546. CONSTRUCTION OF FLOATING VESSELS. JOSEPH WILLIAM ISHERWOOD, OF MIDDLESBROUGH, ENGLAND.

Claim 1.—A vessel in its main body portion provided with consecutive transverse frames individually a plurality of times stronger and spaced a plurality of times farther apart than has heretofore been customary in the same class of vessel, said frames extending to the shell or deck plating of the vessel, said vessel being also provided in said portion thereof with longitudinal frames which, as compared with the transverse frames are individually weak and very closely spaced, and which also extend to the shell or deck plating of the vessel. Twelve claims.

1,028,472. WAR VESSEL. HUDSON MAXIM, OF NEW YORK, N. Y.

Claim 2.—A war vessel having water compartments for its immersion,



with downwardly and forwardly inclined inlet passages, and rearwardly and downwardly inclined outward passages, and valves controlling said passages. Ten claims.

British patents compiled by G. E. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton Building, W. C., London.

18,789. RAISING AND LOWERING GEAR FOR SHIPS' BOATS. A. J. BILLS, STRATFORD.

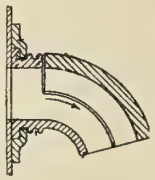
According to this invention, the boat fits in chocks which slide outboard for launching. The davits also are movable in and outboard and are connected to the boat by means of a gunwale-gripping-rod carried by a bar joining them together. When these davits are pushed outboard this rod also pushes out the boat and chocks. The latter are in halves, hinged together beneath the keel of the boat, so that the outer half can drop clear of the boat over the side to allow he boat to swing clear. The davit carriages and chocks are normally prevented from moving by means of pawls and racks and also by readily disengaged links by which the cross-bar is secured to the deck.

16,443. WARMING OR COOLING AND VENTILATION OF STEAMSHIPS AND THE LIKE. D. M. NESBIT, LEICESTER.

This invention has for object a system of warming, cooling and ventilation in which every advantage of the natural elements and speed of the vessel is taken. To this end the fresh air for warming or ventilating is admitted upon the forward side of the funnel casings while the foul air escapes or is forced out on the after side of them. Arrows on the drawings show the air entering to supply blowers which force it into side ducts, whence it supplies the various rooms, etc., returning after use to the rear of the funnel, and issuing at the head of duct. Switches are for controlling the fans. Coils may be provided for heating the air.

22,222. ASH EJECTORS. F. J. TREWENT AND W. E. PROCTOR.

The invention relates to a nozzle for ash-ejectors, curved so as to discharge the mixture of ashes and water in a direction parallel to the ship's side and downward so that the issuing refuse may be kept from



the influence of strong head or beam winds. That part of the nozzle which alters the direction of the issuing stream, and which is consequently most worn by it, is made readily detachable and renewable. Several ways of carrying the invention into effect are described. In one variation the nozzle is rotatable.

7,963. SELF-REGISTERING COMPASSES. A. B. C. THOMSEN, COPENHAGEN.

By this invention the movements of the compass card are recorded by a beam of light transmitted through a lens in the card or reflected from a mirror carried upon it. An electric lamp sends rays to a conical mirror which directs them through the converging lens in the card to a second conical mirror by which they are turned to the recording cylinder. This has no movement of rotation, but falls axially, regulated by an escapement. Then, if the course is held, the record is a straight line. When tacking, the record is a zigzag line, and when turning quite round it is a helix.

15,674. MARINE BOILER AND OTHER FURNACES. R. CAMPBELL, LIVERPOOL.

The rocking fire-bars are provided with auxiliary bars at their rear ends, and hooked upon a supporting bridge in such manner that they provide an air channel and so that they are shaken up and down at the same time as the main bars. Extensions passing between the latter ensure that the auxiliary bars move downwards. The bridge is adjustable for varying the grate area. This arrangement prevents the congestion of dead fuel at the bridge while ensuring better combustion and increased efficiency.

2,812. SEA-WATER EVAPORATORS. W. WEIR, GLASGOW.

This evaporator is of the type in which the heating coils are arranged one above the other and have their two ends connected respectively to steam chamber and exhaust, both in the lower part of the shell. By this invention the chambers are located on the side of the shell opposite the door through which the coils are inserted and withdrawn, and the coils are connected to the chambers by couplings whose axes are parallel to the line of withdrawal of the coils through the door, so that every coil can be disconnected and withdrawn, by a single straight line movement, and can be of a size sufficient to practically fill the horizontal section of the coil containing portion of the shell, which may then be made to occupy the minimum space.

TRADE PUBLICATIONS.

AMERICA

Smooth-On Iron Cement Book No. 7 has just been issued by the Smooth-On Manufacturing Company, Jersey City, N. J. Smooth-On Iron Cement No. 7 is a hydraulic, chemical iron cement, prepared and sold in powdered form and used for waterproofing, stopping leaks of concrete, hardening concrete and for bonding concrete to concrete and brick to brick on any porous substances. The new instruction book is illustrated; the illustrations show a few of the many ways in which this Smooth-On Iron Cement No. 7 has been used and the results obtained. It will prove valuable and interesting reading to anyone troubled with concrete leaks or the hardening of concrete. A copy of this book will be sent free of charge to anyone sending their name and address to the Smooth-On Manufacturing Company, Jersey City, N. J.

A free copy of the 1912 edition of the "Red Book," published by Toch Bros., 320 Fifth avenue, New York, will be sent to any of our readers upon request. This booklet should be in the hands of every person interested in the subject of marine paints and damp-proof coatings of any nature. In this connection it may be stated that the steel hull of the U. S. battleship *New York,* which was launched Oct. 30 at the Brooklyn navy yard, was painted below the waterline with a foundation priming anti-corrosive coating of "Tockolith," a patented cement paint. This composition is also valuable for waterproofing between the decks of boats and for paying seams. It is applied cold, which is a great advantage over other materials. The manufacturer states that it has been used in thousands of places and always with positive damp-proof results. Toch Bros. have been inventors and manufacturers of painting materials for sixty-four years, and after years of practical construction tests have been successful in having their "Tockolith" priming paint adopted for some of the greatest steel structures ever erected. On pages 31 to 41 of the "Red Book" is a technical description of this company's paints. Every shipbuilder, ship owner, superintendent, naval architect and marine engineer should ask for a copy of the "Red Book."

Ventilation and draft fans are described in a catalogue issued by the B. F. Sturtevant Company, Hyde Park, Boston, Mass. In this catalogue the statement is made that on the United States battleship *Wyoming* are installed 40 Sturtevant hull ventilation fans, 12 Sturtevant forced-draft fans, and 12 Sturtevant portable ventilating fans—a total of 64 Sturtevant fans with an aggregate capacity of 565,600 cubic feet per minute. The *Arkansas,* a sister ship, has a similar equipment. The Sturtevant Company is prepared to meet all requirements for fans and electrical apparatus for marine use.

The November issue of the *Nlesco News,* published by the New London Ship & Engine Company, Groton, Conn., is a fuel oil number. "The rapidly increasing demand for suitable fuel oil, made necessary by the success of the heavy oil engine, has led to considerable speculation as to the supply and availability of the work. In this issue of the *Nlesco News* we devote our first page to a discussion on fuel oil, and hope that it will be of interest not only to our patrons interested in our engine, but also to those who have any connection with the production and sale of oils." A free copy of this pamphlet will be sent to any reader of INTERNATIONAL MARINE ENGINEERING upon application.

Steam gages, indicators and other steam specialties are described in a catalogue published by the American Steam Gauge & Valve Manufacturing Company, 208 Camden street, Boston, Mass. "A cheap inaccurate gage, for example, may easily waste its cost many times. An inaccurate indicator will, because of improper valve settings based on its diagrams, waste hundreds of dollars in coal consumed and power lost. The cost of any perfectly-made instrument is quickly forgotten in the satisfaction which always accompanies the use of such an instrument. American quality products are manufactured solely because of the above good reasons. Every instrument is built on honor of the best materials, and by the best workmen that can produce these instruments. We have specialized in the manufacture of power measuring and controlling devices for over sixty years. No other manufacturer in the United States knows so well as we how to produce a perfect gage, a perfect indicator or a perfect safety valve, either for stationary, locomotive or marine use. You are saving nothing by buying cheaper products, and you are insuring yourself, your plant and your service when you equip with American quality products."

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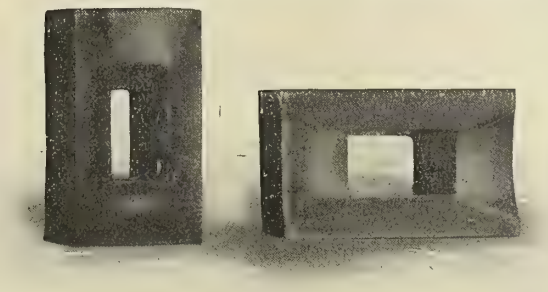

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IMMEDIATE SHIPMENT, ANY QUANTITY
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"Vulcan" safety dogs and other drop-forgings are described by J. H. Williams & Company, 63 Richard street, Brooklyn, N. Y., in a catalogue this company has just issued. These dogs, according to the catalogue, offer safety in simple form, a better balance in the lathe, tempered headless screws and toughened dog wrenches. "The price is the same as for dangerous and otherwise less desirable forms of tools."

Oil Burning Without Steam or Air.—The Körting mechanical system, made by the Schutte & Körting Company, Philadelphia, Pa., atomizes oil by mechanical means, *i. e.,* without steam or air, as the atomizing medium. The system operates smokelessly and noiselessly, and installations in various types of vessels, stationary plants, etc., total over 150,000 horsepower. This system is described in Bulletin 6-0, a copy of which will be sent to any of our readers upon request.

The Auld reducing valve is described in Catalogue 8-R issued by the Auld Company, 1255 North Twelfth street, Philadelphia, Pa. "This well-known reducing valve, made for so many years by the Auld Company, Glasgow, Scotland, is now made in the United States by the Schutte & Körting Company. We have already sold a large number of these valves and they are giving absolute satisfaction. The valve is extremely accurate, and having no sleeves or shifting boxes there is no friction, therefore no irregular working. Constant reduced pressure is maintained even with great fluctuations in initial pressure."

"Graphite in Boilers" is the title of the leading article in the November issue of *Graphite,* published by the Joseph Dixon Crucible Company, Jersey City, N. J. After reproducing an interesting article on this subject, which was recently published in *Power,* the Joseph Dixon Crucible Company goes on to state: "The action of graphite in boilers is purely a mechanical one, and so the grade used must be one that will not have a tendency to pack and collect in one place, but rather one which will spread out evenly over the whole boiler surface. Dixon Ticonderoga flake graphite is well known for its ability to stay placed upon metal surfaces, and has been found best adapted for boiler requirements." Detailed information as to use, etc., will gladly be furnished upon request.

"Prompt vs. Dilatory Freight and Merchandise Handling" is the subject of a catalogue issued by the Otis Elevator Company, Eleventh avenue and Twenty-sixth street, New York. All who are interested in the problem of economically handling large volumes of freight or merchandise in transit, or in steamship piers and storage warehouses, should send for a free copy of this catalogue. "In construction the Otis inclined elevator is extremely simple and can be comprehended by a study of the illustrations in this book. It consists, primarily, of an endless steel chain or platform revolving about sprockets at either end which are driven by a conveniently located motor. The elevator can be started, stopped, or reversed at any point during its travel. In operating, the truckman brings his loaded truck to the elevator; the flange or lug of the elevator engages with the truck, and the man, truck and load are transported from level to level, quickly, safely and without physical effort. The operator may, or may not, as so desired, accompany the load on its transfer from floor to floor. No matter what kind of truck is used, how much the loads may weigh, or how fast they come, the Otis inclined elevator will move them promptly and surely. From the initiation of the load until its delivery at destination it remains intact. It is particularly adapted to the varied merchandise of department stores; parcels in express offices and railroad stations; freight to and from vessels and docks; freight at railroad terminals; bags, bales, boxes and packages in stores and warehouses; transfer or finished parts, or merchandise in process of manufacture in mills and factories. On the following pages are illustrated the many types of inclined elevators which we manufacture, showing complete installations and typical layouts of the apparatus. In order to estimate the cost of Otis inclined elevators it is necessary for us to know the distance from floor to floor, or rise, location and size of beams; also floor construction, whether wood, concrete, or other material and depth of same. To help you prepare this information we refer you to the typical layouts of each type of inclined elevator. When writing for information please make reference to the typical layout sheet number, and without obligating you in any way we will prepare specifications and estimates of any machine to meet your specific requirements. If you own or manage or are planning to build a store, factory, freight terminal or building, where merchandise should have constant movement, or have old buildings you want modernized to produce large income, we invite you to make a thorough investigation of the Otis inclined elevator. Any of our offices will be pleased to have your inquiries."

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You don't need to watch the dial, for the knob on the revolving disc passes under the thumb at every 100 revolutions. It will indicate accurately the high speed of those turbo-auxiliaries without heating. Has rubber tips for pointed and centered shafts—won't slip.

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You Can't Blow Off the Bonnet Rigging of the
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The patent ground joint connection between "A" and "N" and hexagon swivel nut "a" prevents that. The higher the pressure the tighter the grip—plenty of strength and metal where the body might be weak. You don't need red lead to make it steam tight after you have taken it apart for inspection or repairs, the steam doesn't reach the threads.

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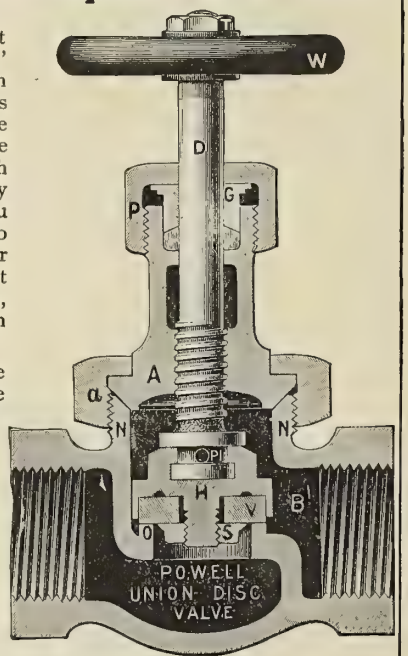
Look for the Name—



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WINTERTHUR, SWITZERLAND.

Gasoline electric generating sets are the subject of Catalogue 205 just published by the B. F. Sturtevant Company, Hyde Park, Mass. "Sturtevant gasoline generating sets consist of Sturtevant gasoline engines direct connected to Sturtevant direct-current electric generators. The engine is of the four-cycle, water-cooled vertical type, with either four or six cylinders, according to the size of the unit. These sets are built in three sizes—5, 10 and 15 kilowatts capacity, capable of lighting 200, 400 or 600 twenty-candlepower tungsten lamps. A long-stroke engine has been designed as the most efficient and practical for this service. Both engine and generator are capable of operating under an overload of 25 percent for two hours."

The Penberthy Injector Company, Detroit, Mich, is sending out an 80-page book, and every superintendent and engineer at all interested in engine and boiler room practice should have a copy. It is complete with illustrations of injectors, ejectors, regrinding valves, safeguard water-gages, etc. "It thoroughly describes them, gives many facts to be considered in the selecting and handling of injectors, methods of connecting, information regarding repairs, tables of capacities, and really gives a great deal of information that will come in handy to any engineer, and the Penberthy Injector Company offers to send it free of charge to those who care to write for it, mentioning INTERNATIONAL MARINE ENGINEERING."

The Watertown automatic safety water gage is described in a folder published by the Watertown Specialty Company, Watertown, N. Y. "We bring the Watertown automatic safety water gage to your attention secure in the knowledge that there is no other possessing all the qualities of automatic safety action; automatic release of valve when glass is replaced; replacement of glass without shutting off valves by hand; impossibility of false water level; accessibility to all passageways for cleaning without removing from boiler; automatic cleaning of safety check valves when the glass is blown down; top and bottom valves interchangeable; automatic action when closing and opening when glass breaks or is replaced. All requirements of the Inter-State Commerce Commission are met with."

In a 120-page book, entitled "De Laval Steam Turbines, Multi-Stage Type," the De Laval Steam Turbine Company, Trenton, N. J., has presented much more than an ordinary trade catalogue. A third or more of this publication is devoted to a discussion of the "speed compromise" problem; that is, of finding the best means of reconciling the high speed natural to steam turbines with the low or moderate speeds of driven machinery. The relative advantages of the several fundamental types of turbines, as affecting this and other matters, are discussed under the following chapter heads: "The Field of the Single-Stage Turbine"; "The Necessity for Multi-Stage Construction for Large Turbines"; "Advantages of Speed Reduction by Gears"; "Considerations Affecting Choice of Type of Turbines"; "Relation Between Rotative Speed and Number of Stages"; "Effects of Different Methods of Compounding"; "Choice of Type of Turbine"; "Benefit of the Driven Machine from Being Able to Obtain the Proper Speed"; "Alternator Speeds"; "Direct-Current Generator Speeds"; "Centrifugal Pump Speeds"; "Fan and Blower Speeds"; "Speeds for Rope and Belt Drives." The remainder of the book is occupied by a detailed description of the design and construction of the De Laval multi-stage or multi-cellular turbine, which is built in capacities of 500 horsepower and up, and of the De Laval speed reducing gear, by means of which this turbine is applied to driving standard speed, direct-current generators, centrifugal pumps and blowers, and for rope and belt drive. "A novel feature in the construction of the De Laval multi-cellular turbine is the use of solid steel rings, which are shrunk over the stationary guide vanes of the diaphragms, entirely encircling the wheels. These rings provide an impenetrable steel armor, which will effectually prevent injury to surrounding objects or persons in case the turbine should be over-speeded, as through lodgment of objects under the governor valve. A chapter at the end of the book is devoted to showing that because of their lower first cost, steam turbine-driven centrifugal pumps can compete successfully with the most efficient triple-expansion pumping engines wherever coal does not cost more than $6.00 to $8.00 per ton. The book also contains a chart accompanied by a "steam scale," by means of which the energy available from the expansion of steam between given limits can be read off directly as heat units, velocity of the steam in feet per second, duty in foot pounds per thousand pounds of steam, and pounds of steam consumed per horsepower-hour. Copies of this book will be sent upon request to those concerned in the management or operation of steam plants."

When writing to advertisers, please mention INTERNATIONAL MARINE ENGINEERING.

Reducing valves are the subject of Bulletin No. 4, published by the Lytton Manufacturing Corporation, Franklin, Va. "They shut off when consumption stops. Reduced pressure can be changed while in operation."

The velocity stage type of De Laval steam turbines is described in a 48-page booklet recently issued by the De Laval Steam Turbine Company, Trenton, N. J. "This is a velocity stage turbine with a single pressure stage, built in sizes up to 600 horsepower, suitable for direct connection to centrifugal pumps and blowers and small alternating-current and direct-current generators, etc. With the intermediation of gears the turbine may be adapted to drive slow and standard speed machinery, also for use with rope or belt drives. The pamphlet outlines the factors affecting the suitability of different types of turbines for the several services involved; the speed problem, as bearing upon the type of turbine to be selected; methods of velocity staging for small turbines, such as the use of multiple rows of buckets with intervening guide vanes, or returning the steam jets upon the original row of buckets, and practical considerations, such as renewability, governing, non-penetrable casings, shaft design and freedom from vibration, bearings, the strength of wheels, the best form and material of buckets to resist erosion, ease of access to internal parts, economy, facilities for changing the nozzles to meet changes in steam conditions, etc. The turbines here described and illustrated by 31 views and installations embody several distinguishing features, some of which are novel. For instance, all openings are in the bottom part of the casing, so that the cover may be lifted off without disturbing steam or exhaust connections. This exposes all rotating and working parts, which may then be lifted out after removing the bearing caps. All wearing parts, such as nozzles, buckets and guide vanes, are renewable without involving the renewal of other parts. The wheels are surrounded by a solid steel ring, sufficiently heavy to prevent penetration of parts of the wheel in case the latter should be ruptured by over-speeding. Possibility of such accident is guarded against by a duplicate governing device operating an entirely independent valve. This form of turbine is built for all steam conditions, *i. e.*, receiving high-pressure steam and exhausting to condenser or atmosphere or against back pressure, or operating on low-pressure steam, either alone or with mixed flow. Copies of the book will be sent gratis to those interested in steam power plant equipment."

"Sirocco" fans are described in Bulletin 340-ME., published by the American Blower Company, Detroit, Mich. "Sirocco fans deliver more air at less expense for power than the ordinary steel plate fan of twice the size."

"Diamond" soot blower is described in Bulletin 1, published by the Diamond Power Specialty Company, 58 First street, Detroit, Mich. The steamer *Col. James M. Schoonmaker*, the largest steel bulk freighter in the world, is equipped with "Diamond" soot blowers, and the chief engineer of the ship states that these blowers are extremely satisfactory, and that they do all that could be expected of them.

"J-M Permanite Packing" is the subject of a bulletin published by the H. W. Johns-Manville Company, Forty-first street and Madison avenue, New York. "J-M Permanite Sheet Packing No. 60 is adapted for high or low superheated or saturated steam; hot or cold water at any pressure; air, oil, ammonia and various acidulated and alkali solutions. The company will send a square foot of this packing as a sample, free of charge, to all those interested."

Class C turbines are the subject of booklet G46, published by the De Laval Steam Turbine Company, Trenton, N. J. "The shaft is exceptionally large, and each row of buckets is mounted on a separate wheel rather than upon the broad rim of one wheel. There are two governors—one a speed governor and the second an independent emergency governor which trips a safety shut-off valve. In any case damage to wheel case or surroundings is absolutely prevented by the heavy steel retaining ring. A safety relief valve is attached to the casing cover. Made in all sizes suitable for the driving of power plant auxiliaries."

The subject of safety and greater reliability in the navigation of sea-going vessels which travel or dock at night is taken up in bulletins published by the General Electric Company, Schenectady, N. Y. According to the bulletins, safety and reliability in the above-mentioned circumstances are secured by the use of the General Electric Company's searchlights, built especially for marine service. The company is prepared to furnish from stock standard commercial projectors of 9, 13 or 18-inch diameter for either pilot-house or hand control. Larger sizes up to 80-inch diameter and projectors suitable for special requirements of control are furnished to meet every condition of marine work.

Are Your Auxiliaries Giving Satisfaction?

The "Harvester" has two 15-Kw. TERRY Turbo-Generators

They ARE
if they are driven by

TERRY TURBINES

After exhaustive tests the United States Government has installed Terry Turbines in ship after ship and for all sorts of purposes. The big naval review in New York Harbor last Fall showed fifty-three Terrys on twenty-one different vessels. Some of these were turbo-generators, some were forced draft blowers, and some were pumps. They are also being used more and more in the merchant marine and particularly on the Great Lakes. A recent order put eight Terry Turbine generators upon the vessels of the Erie Railroad Transit Line. This popularity is based upon results, as shown both in low steam consumption and in absolute reliability and freedom from breakdown.

You will readily understand why it is that small turbine driven sets are replacing engine driven generators and direct acting pumps when you consider that turbines take up less room, weigh only one-half as much, and are a great deal more efficient than the reciprocating type. All of this makes a smaller drain upon the ship's boilers and when carried out to its last analysis makes it possible either to carry more cargo or to use smaller hull dimensions. We have bulletins covering Terrys for all classes of work. Bulletin No. 16, recently issued, deals particularly with marine work, and shows why Terrys are best for driving generators, pumps, forced draft sets, and other auxiliaries on shipboard. Send for your copy today before it slips your mind. **Marine Bulletin No. 16 ready for you.**

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"Autogenous Welding" is the subject of circulars distributed by Messer & Company, The Bourse, Philadelphia, Pa. "One of the latest and most important auxiliaries in iron and metal working is supplied by the autogenous welding of metals, chiefly by means of the acetylene oxygen flame, which is equally well adapted for welding wrought and cast iron, steel, copper and other metals, at the same time dispensing with the application of hammering, pressure, solder or any other means of fusion during welding, there being, in fact, a smelting together or conflux of the metals. Instead of using complicated joining methods that require rivets, screws and the like, the work is done efficiently in a far cheaper way. Formerly expensive and time-wasting repairs of ruptures and fissures in machine parts, steam boilers and other receptacles can now be made most expeditiously and at a relatively small cost. Casting faults in iron and metal foundries can be rectified in the most simple and efficient manner. An acetylene oxygen welding plant, notwithstanding its extraordinary advantages, is of surprising simplicity in construction and operation. Hence it will presumably be introduced before long as indispensable in the largest industrial concerns as well as in the smallest workships. The acetylene oxygen welding is by two-thirds cheaper than the autogenous welding of metals by means of hydrogen and oxygen. Moreover, it admits of the welding, for instance, of iron up to a thickness of 2 inches without preliminary heating, whereas this can be done with the other welding methods referred to only up to a thickness of ⅜ inch. Our welding blow pipes are provided with contrivances of the greatest importance (the patent for which has been applied for), and are remarkable for their unexceled economy in gas as well as for their faultless working. They have stood the test of efficiency so extremely well as to be distinguished by the gold medals as the highest awards. We can furnish the highest references. Our apparatus are in operation by the railroads, in the navy, in large industrial concerns as well as in small factories and workshops, and invariably give the greatest satisfaction. We are always prepared to demonstrate to any interested parties the acetylene oxygen welding process in progress in our own works. The welding of all metals can be acquired within a few days free of charge in our own works. Or we send professional welders to teach interested parties outside of our establishments at very moderate charges."

Improved rotary bevel shears are described in an illustrated catalogue just published by the Hilles & Jones Company, Wilmington, Del. The claim is made that these rotary bevel shears combine all the latest improvements in design, and that they are constructed with an excess of strength beyond the rated capacities. "For many classes of work a totary bevel shear is as satisfactory as a plate planer, and the saving in time over edge planing is an important consideration. On curves and irregular shapes it is invaluable compared with hand work."

"The Hunt Automatic Railway" is the title of a 32-page booklet issued by C. W. Hunt Company, West New Brighton, S. I. "The Hunt automatic railway was designed primarily for transporting coal, sand, phosphate rock, ores, limestone, salt, cement and similar bulk materials from railroad cars and vessels to storage bins or pockets where the run does not exceed 600 feet. So many of these railways have now been installed in all parts of the country and are operating under such a wide range of conditions, some continuously during the past forty years, that we can submit any number of performance records to prove that they afford absolutely the most economical and satisfactory means of accomplishing their purpose. The cost of operating this elevated self-acting railway is confined to the expense of one man's wages, for the car, once loaded and started, runs down the track, dumps its load at any desired point, and returns to the starting place entirely under the action of gravity. The workman does not even accompany the car; the operation is so entirely automatic that no attention whatever is required from the time of starting with load until the return empty and ready for the next load. Moreover, the car runs with great rapidity, making a trip of 300 feet, dumping its load and returning in about fifty seconds. Materials received over the automatic railway can be accurately weighed without delay or extra expense by placing platform scales in the track at the loading end; the workman who loads the car also weighs it, and while the car is running down the tracks enters the weight in the tally-book. Almost any area within a radius of 600 feet can be covered by having the required number of automatic railways radiate from a central receiving point, the capacity being limited only by the number of cars in operation. Where there is no time limit one car switched from track to track can be made to cover the entire storage space."

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Rotary pumps, feed-water regulators, disk fans for ventilation, positive-pressure blowers and blowers for mechanical draft are described in a folder published by the L. J. Wing Manufacturing Company, 352 West Thirteenth street, New York.

The Wisconsin Carbonic Safety System for refrigeration and ice-making is described in a circular issued by the Wisconsin Ice Machine Company, 322 South Michigan Boulevard, Chicago, Ill., and a statement is made regarding the case of "The Carbonic vs. the Ammonia Machine."

The Star "non-corrosive" steam gage is described in an illustrated circular published by the Star Brass Manufacturing Company, 108 East Dedham street, Boston, Mass. This circular states that the Star gage is the only one made with a movement that won't rust. "Both the non-corrosive and corrugated tube features are patented and found only in our make."

Marine engines are described in a catalogue just issued by the Wolverine Motor Works, Bridgeport, Conn. This company makes both oil and gas engines, and makes a specialty of commercial installations. In the catalogue are numerous halftone illustrations, showing towboats, freighters, schooners, launches, oyster boats, etc., in various parts of the world, which have been equipped with Wolverine motors.

"From the Scrap Heap to the Drill Press" is the title of folder 19-H published by the Cleveland Twist Drill Company, Cleveland, Ohio. In this folder the statement is made that any taper shank drill with its tank twisted off can be restored to its original usefulness more easily and more quickly than you can grind its point when dull. "Three minutes' grinding puts on a new and stronger tang below the one that is twisted off. The new tang fits the lower slot."

Turbines for marine and stationary use are described in a large new catalogue just published by the Kerr Turbine Company, Wellsville, N. Y. All of our readers interested in the subject of turbines should send for a free copy of this catalogue. One user of Kerr turbines writes to the manufacturer: "There has been no money spent for maintenance of the turbines and no money spent on attention. They are started by the oiler, bearings examined once every eight hours and the turbine looked over. The oil in the bearings is changed monthly, otherwise they take care of themselves."

"Appliances for Burning Fuel Oil" is the title of a handsomely printed and illustrated catalogue just published by Tate, Jones & Company, Inc., Pittsburg, Pa. "Oil first came into use as a fuel in the field of steam raising, and in this field it has many distinctive advantages over solid fuels. When properly burned it has no injurious effect on the boiler; on the contrary, the boiler's life is lengthened and the cost of its maintenance is lessened. This applies to both fire and watertube boilers. With oil the temperature is kept constant, and chilling drafts in the fire-box are avoided because the furnace doors are never opened while running. Better regulation can be obtained, and overloads or a sudden decrease in load can be instantly taken care of. Oil gives a smokeless fire and leaves no ashes. There are no flues to clean, no clinkers to remove, and no grate-bars to replace. The transmission of heat is at a maximum at all times, as there is no insulating layer of soot deposited on flues and tubes. A greater evaporation per square foot of heating surface is obtained and a saving of about 25 percent in labor. Besides these advantages, we have a reduction of about 40 percent in weight and of about 35 percent in bulk of the fuel, which is of great importance in marine and locomotive work. The economy in fuel of using oil will differ in different localities, depending on the prices of oil and coal, but there are fundamental economies with oil which are shown by the advantages enumerated above, and also from the fact that oil is more easily handled than coal, can be stored at less cost, does not deteriorate when stored and there is no danger of spontaneous combustion. In localities where oil is plentiful there is no question as to its economy as a fuel, but even in localities where oil is comparatively expensive, it is being widely used in a great many industries where the improved product of the manufactured article more than counterbalances the difference in price of the two kinds of fuel. It lends itself particularly well to the operation of metallurgy, because a clean heat is secured as well as a uniform temperature. In the smelting of ores and refining and working of metals the comparative freedom from sulphur of most kinds of oil, and the fact that either an oxidizing, reducing or neutral atmosphere may be maintained, makes it an ideal fuel. Forging and heating of all kinds can be started up and shut down instantly with fuel oil, and we have an early attainment of the maximum temperature with accurate and easy regulation, which is very desirable."

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INTERNATIONAL MARINE ENGINEERING

17 BATTERY PLACE, NEW YORK

"S & N" heavy-duty beam shears, coping machines and bar and angle cutters, are the subject of a handsomely printed 32-page catalogue just published by the Wiener Machinery Company, Church street, corner Dey street, New York. In this catalogue the following description is given of the "S & N" type T-40, motor-driven, heavy-duty beam shears: "For many years this machine has been considered a standard tool, inasmuch as it has been found so satisfactory by hundreds of customers all over the world. This type is of particular interest to fabricators of structural work, iron and steel dealers and metal manufacturers. Our type T machine combines utmost strength with greatest simplicity. The actual cutting requires less time than any friction saw. It possesses all advantages of a special tool without having the disadvantage of being complicated, so that any man can handle it. The design is heavy and massive. All dimensions are ample to secure working without breakdowns of any kind. The frame consists of very heavy rolled steel plates, which are machined on the inside before being riveted together, so that the inner working mechanism has smooth guiding surfaces. Bushings, bolts, etc., have good and substantial bearing, and repairs will be practically unnecessary. The working parts are of forged and, wherever necessary, hardened steel. Gearing is made of high-grade cast steel with cut teeth, and consequently the machine will run smoothly and noiselessly. The knives of the 'S & N' beam shears are made of the finest tool steel, and the quality, together with the design, makes the knives last for many years. The 'S & N' heavy-duty beam shears cut beams and channels without the necessity of turning them over, the same knives being used for different shapes. The 'S & N' beam shears require one-fifth to one-third of the power of high-speed saws, and still cut faster than these. After the cut is made, the beam cut by an 'S & N' machine is ready for shipment, while the beam sawed has to be freed of the fin. There is no screwing required when placing a beam in an 'S & N' shear. The machine is always ready; the upper knife returns automatically into its initial position after a cut has been made. The operator does not leave his place in front of the machine. The price of a complete installation of 'S & N' beam shears, including all the knives, motor and foundation, is less than that of high-speed saws or of hydraulic machines, while the operating expenses of the 'S & N' machines is far below that of any other tools for the same purpose."

"Regrinding Valves" are the subject of a book of questions and answers issued by the National Tube Company, Frick building, Pittsburg, Pa. The N. T. C. regrinding valve has been on the market for some years. "From time to time certain questions are asked, and we have endeavored in this pamphlet to give replies to the most common queries."

A bolt heading, or forging furnace, which uses oil or gas fuel is described in a catalogue published by Tate, Jones & Company, Pittsburg, Pa. This furnace is especially designed for light forging, and is simple in design, being built of cast iron plates bolted together and lined with asbestos board and firebricks. It is built to heat stock up to 4 inches square, and will make heats 50 inches long. The burners fire from below the work and the material is heated quickly and uniformly.

"Chicago Pneumatic Compressors for Air and Gas" is the title of a booklet issued by the Chicago Pneumatic Tool Company, Fisher building, Chicago, Ill. "To convey at a glance an idea of the wide range of compressors we manufacture is the sole purpose of this brochure. A selection only of our line of 200 types and sizes is herein illustrated in miniature, with a few words by way of description. We publish a complete series of bulletins describing in detail all types of Chicago pneumatic compressors. These and full specifications will be sent upon request made to our nearest office."
and Lundin boats and other lifesaving appliances at the meeting of the Lifeboat Board, Oct. 23, at Newport News, Va. The company also had standard davits and a new Welin boat

TRADE PUBLICATIONS

GREAT BRITAIN

A tool steel testing machine for testing the cutting efficiency of tool steel is made by Edward G. Herbert, Ltd., Atlas Works, Levenshulme, Manchester. "This machine provides for the first time a means of rapidly and accurately ascertaining the actual cutting properties of tool steels; their durability at various speeds; their suitability for different duties; the best methods of hardening them, and the comparative value of various cutting compounds. The durability of tool steel is measured by the number of inches it will turn from a standard test tube of tough steel before the cutting edge becomes worn by a definite amount."

WELIN MARINE EQUIPMENT COMPANY

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WELIN DAVIT and LANE & DE GROOT CO., Consol., 305 Vernon Ave., Long Island City, N. Y.

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Welin Quadrant Davits

in 60 Types and Sizes

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in all Sizes and Styles

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To meet all requirements

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WE ARE EXPERTS IN FURNISHING COMPLETE LIFE SAVING APPLIANCES

Send us your deck plans and full information and we will tell you how best to meet the Law and be really safe. Better be safe than sued.

OUR LONDON HOUSE IS

THE WELIN DAVIT and ENGINEERING COMPANY, 5 Llyods Avenue, ENGLAND

Belting, packing, etc., are the subject of a 42-page catalogue published by Small & Parkes, Ltd., Hendham Vale Works, Manchester. "Having devoted over thirty years to manufacturing engine packings, we can justly claim to be specialists in this important line. We offer you the results of our experience, and if you entrust your packing to us we are confident of being able to save you money, time and trouble. We do not offer one packing designed to suit every requirement, but we make modifications to cope with the different classes of work."

Electric winches, capstans and haulage gears are described in list 14-B, published by Clarke, Chapman & Company, Ltd., Victoria Works, Gateshead-on-Tyne. "In issuing this list it is our desire to illustrate and describe some of the more usual of the many designs of winches, windlasses, capstans, haulage and winding gears which we supply, in the hope that our friends may find therein something that will help them in the selection of such a plant. The very varying conditions under which this class of plant has to work and the very rough usage to which it is often subjected, make special precautions necessary in some cases which can well be dispensed with in others, so that it is difficult to give prices in a list of this kind that would be of any general utility, but we are always pleased to carefully consider inquiries when full particuars of the duty required and conditions of workings are submitted to us."

Gas engines and suction gas plants are described in a catalogue published by Kynoch, Ltd., Witton, Birmingham. "In this catalogue we refer to the high standard of workmanship and material employed in the construction of our gas engines, and venture to point out that our facilities for maintaining this standard are quite exceptional in the gas engine trade. While our gas engine works are distinct, and were specially equipped and staffed for this branch of engineering, we employ a large staff of expert metallurgists, chemists, tool designers and makers, with suitable apparatus for the examination and testing of material in connection with our important iron, copper and brass mills (our large foundries producing enormous castings), and several other engineering shops. For the above reasons we are also able to secure supplies of the highest standard of material, and it will be obvious that this is an advantage to our customers which cannot be offered by all firms engaged in the manufacture of gas engines alone."

BUSINESS NOTES

AMERICA

A STORY FOR ENGINEERS.—"McAndrews' Floating School" begins in this number of INTERNATIONAL MARINE ENGINEERING. It is much easier to read a good story and remember the thousand and one ludicrous incidents than to study a serious textbook. Thousands of men hesitate to read such a book, and it is for these men that "McAndrews' Floating School" is written. The oilers and firemen who figure in this engineering story start in at the very beginning, below the grating of a steamship, and work up step by step. They have many amusing experiences before acquiring the knowledge necessary to take out their first papers. All that the law requires them to know to get their licenses, either from the Board of Trade or the United States Steamboat Inspection Service, is woven into the story, so that the reader unconsciously absorbs a vast amount of practical and necessary information. The object of "McAndrews' Floating School" is to make it possible for a man who wants to secure a marine engineer's license to absorb the necessary information, and enjoy the operation so much that he does not realize that he is studying hard. He only realizes that he is reading the best and most amusing story ever written for engineers. The author is Capt. C. A. McAllister, engineer-in-chief of the Revenue Cutter Service—one of the best-known writers on marine engineering subjects. Many of our readers will remember Capt. McAllister's splendid story for marine engineers entitled "The Professor on Shipboard." Inspector-General George Uhler, of the Steamboat Inspection Service, writes: "I have read the first two chapters of 'McAndrews' Floating School,' written by Capt. C. A. McAllister, of the Revenue Cutter Service. It is written in his usual happy vein, and with his intimate knowledge of every feature of the subject, its purpose and its designed effect, it cannot fail to be interesting to everyone, and particularly useful and helpful to the beginner, who is the child of his thought and the beneficiary of his expression. The idea of putting out what promises to be a textbook in the shape of an interesting story could have had its inception only in the mind of Chief McAllister. Nobody else in the world would have ever thought of such a thing, and I sincerely hope that it may receive all the credit that its excellence and importance deserve."

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If ordered in connection with a new or renewal subscription to INTERNATIONAL MARINE ENGINEERING (price $2.00 domestic; $2.50 foreign) the two will be sent for $3.00 domestic or $3.50 foreign.

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MARINE ENGINE INDICATING

By CHARLES S. LINCH, M. E.

So far as we are able to discover this is the only important book exclusively for marine engineers published for years. It is a broad treatise on the art of indicating marine engines and contains over two hundred actual and typical cards, with explanations that cannot fail to be of greatest assistance to any engineer.

Most text books on the subject of indicating are confined to stationary engines, but this book is confined strictly to the marine side of the subject and fills a long-felt want. That a thorough treatise on this all-important device, with special reference to its application to marine engines, was greatly needed is obvious to every marine engineer, as it has been the author's observation that text books written on the subject of indicators are invariably based on experience with stationary engines.

In the analysis of diagrams it is important, when adjustment of valves must be made, to be able to construct and discuss the valve diagrams, and the object of this book is to *explain* the methods in a clear manner, eliminating all geometrical proof. All diagrams shown were taken, in actual practice, from modern marine engines.

CHAPTER I

The Indicator: Its Construction and Application.

CHAPTER II

Diagrams: Their Computation and Combination.

CHAPTER III

Diagrams: Modern Marine Engine Practice, from Single Cylinder to Four Cylinder Triple Epansion.

CHAPTER IV

Valve Diagrams: Their Construction and Use.

ADDENDA

Plates showing Construction of Valve Diagrams; Combined Indicator Diagrams; Sectional Diagrams of Modern Marine Engine and General Arrangement of Triple Expansion Engine—showing Reducing Motion, etc.

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The new rules of the Supervising Inspectors demand independent air tanks. Note them in illustration of our life boat.

Is your equipment for life saving up to the demands of the Law?

Better be sure than sued.

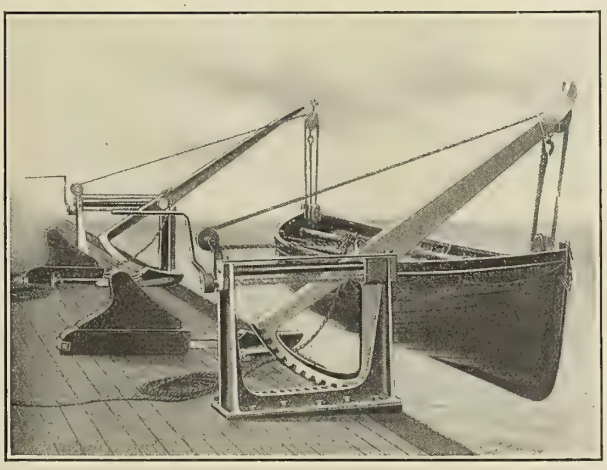
Welin Marine Equipment Co.

305 Vernon Ave.
Long Island City, N. Y., U. S. A.

Formerly Welin Davit and Lane and De Groot Co.

Our life boats are the best made but they would be useless if they could not be got overboard.

With our Welin davit, two men can do this with ease even with a loaded boat.



We make these Welin davits in 60 sizes and shapes.

DAVITS

The Application of Marine Glue to the Beams of Decks.—L. W. Ferdinand & Company, 301 South street, Boston, Mass., are sending out the following instructions regarding the application of Jeffery's marine glue: "Do not attempt to heat all the marine glue you expect to use at once. Heat only what is necessary for immediate use, and as soon as it is half used out of the kettle add fresh glue, keeping it stirred now and then. It should be used as soon is it is melted and not allowed to stand in the kettle. Continued boiling hardens and injures the glue. Almost without exception, unsatisfactory results in using this material are occasioned by faulty application and are produced entirely by two causes. First, if either the oakum or cotton calking or the seam is damp when the glue is applied, as soon as the sun shines on the deck the heat will turn this moisture into steam which will force the glue up over the edge of the seam. Second, in paying the seam the ladle should be held at least an inch above the deck—if the ladle is drawn on or close to the seam a quantity of atmosphere will envelop, and has no time to escape before the glue becomes set. This will cause air bubbles, which in hot weather will also force the glue up over the edge of the seam, leaving it hollow and unsound. The seams must be absolutely dry and clean before the glue is run into them. If applied to old work, the old material should be dug out perfectly clean. Whatever adheres to the sides should be removed with a rase knife."

The Welin Marine Equipment Company, Long Island City, N. Y., had a complete exhibit of models of Welin davits and Lundin boats and other lifesaving appliances at a meeting of the Lifeboat Board, Oct. 23, at Newport News, Va. The company also had standard davits and a new Welin boat installed for test on board the transport *Kilpatrick*. Mr. Axel Welin came over from England to be present at these practical tests, which were made under the direction of the board. The model of the arrangement of the lifeboats and davits, as supplied by the London house of this company for the new Hamburg-American liner *Imperator*, was most interesting, and the very difficult problem of stowing the necessary lifeboats with the crew of such an immense ship and its passengers seems to have been most admirably settled. The large order for lifeboats made under the new rules of the Board of Supervising Inspectors is now being rapidly filled by the Welin Marine Equipment Company for the New England Navigation Company, and the quadrant davits for the *Commonwealth, Priscilla, Providence* and *Plymouth* are partly installed on these steamers. Capt. A. P. Lundin, president of the company, goes soon to the Pacific Coast to be present at the tests which are to be undertaken for lifesaving appliances.

Marine Refrigerating Plants.—The Brunswick Refrigerating Company, New Brunswick, N. J., writes us, under date of Nov. 15, regarding an order received from Barber & Company, 17 Battery Place, New York: "We have just received an order from Barber & Company for the installation of one of our 1-ton plants on board the steamship *Shimosa*. This is the standard Brunswick direct-connected outfit for cooling a little box 8 by 7 by 6 feet high inside. The *Shimosa* sails for the Far East, Singapore and the Red Sea, on the 24th. The order was entered Nov. 14, yesterday, and be assured that the boat will sail with the plant running properly after a good test run, even if there are only nine days to do the work in. As soon as the job is finished we will write and give you more details. This machine will operate under the most trying conditions, the temperature of the condensing water is very high, and also the temperature of the atmosphere is high and the humidity great. The effect of the warm condensing water is counterbalanced by the installation of an especially large ammonia condenser. In spite of the fact that the machine is only 1-ton capacity, the condenser will be 15 feet long, 4 pipes, 1¼-inch and 2-inch pipes. The refrigerator will be built of 2-inch compressed corkboard, with lumber on either side, and three more thicknesses of lumber, making two 1-inch air spaces. The various thicknesses of lumber will be backed up by fourteen thicknesses of two-play heavy insulating waterproof paper. The insulation over all will be about 8 inches thick, and will be built for holding a temperature of 20 degrees in the refrigerator, with an outside temperature of 90 degrees. This is a typical little Brunswick job, just the kind of work that the Brunswick Refrigerating Company is looking for. It does not make any difference how small the boat is or how little room there is on it, there is room for a Brunswick, and a Brunswick may be operated economically wherever 50 pounds of ice a day is used for refrigerating purposes."

When writing to advertisers, please mention International Marine Engineering.

Walter B. Snow, publicity engineer, 170 Summer street, Boston, Mass., has recently increased his staff by the addition of Fred. R. Lufkin, formerly of the instructing staff in electrical engineering of the Massachusetts Institute of Technology, and late assistant superintendent of lighting and wires, Brookline, Mass.

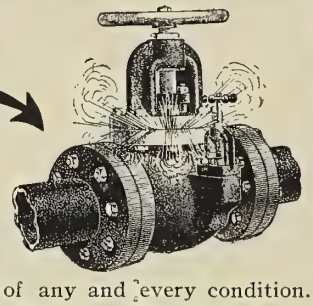
Neutralizing Fire Afloat.—A number of recent serious fires on ships have called attention once more to the fact that perhaps the greatest dread of all those who "go down to the sea in ships" is the ever-present menace of fire. It does not need the example of the *General Slocum* to point the moral that adequate advance preparation is the only real security. The latest and largest passenger steamer on the Great Lakes, the *City of Detroit III.*, has been protected against this possibility by a system of Grinnell automatic sprinklers, which covers all the vulnerable parts of the vessel, and provides a certain and complete answer to any fire which might originate. These are distributed throughout the cargo and baggage spaces, in the pantries and galleys, and in all other locations where the nature of the contents would be liable to cause trouble. In addition to the sprinklers there is a complete fire alarm system throughout the vessel; the hull, including the large deckhouse, is subdivided by fireproof partitions and fire doors, so that in those portions where the sprinkler protection is not available the spread of a fire would be so completely limited that the crew would have a comparatively easy task in coping with it. The main reliance, however, is placed, as always, upon the automatic means for both discovering and extinguishing fire. The alarms, showing on the annunciator the location of each incipient blaze, and the sprinklers, putting it out before it can gather headway, form the only complete answer to the fire problem as it exists afloat.

BUSINESS NOTES

GREAT BRITAIN

The Engineering and Machinery Exhibition which was held at Olympia from Oct. 4 to 26 was unusually successful. Among the large number of representative firms who exhibited we notice the following: *James Archdale & Company, Ltd., Birmingham,* exhibited machine tools of the most recent design, arranged for the use of high-speed cutting steel tools, all driven under working conditions by electric motors, thus eliminating all overhead shafting and its attendant belting. *H. W. Ward & Company, Ltd.,* Birmingham, showed a representative selection of their capstan and turret lathes, milling machines and ball bearing drills. *Vickers, Ltd.,* Vickers House, Broadway, Westminster, London, S. W., showed a large assortment of electrical machinery, such as motors of various types, high-power drills, adjustable reamers, etc. *At the stand of Hans Renold, Ltd.,* Progress Works, Brook street, Manchester, every department of power transmission by chain was effectively represented. These chains may be briefly classified under the three heads of silent, roller and block. *A. Herbert, Ltd.,* Coventry, had two stands showing a number of up-to-date labor-saving machine tools also a number of small tools. *Henry Pels & Company,* Lincoln Chambers, 9 Portsmouth street, Lincoln's Inn Fields, London, W. C., exhibited a number of machine tools, such as joist shears combined with a universal punching machine; a double-ended universal punching and shearing machine combined with a bar, angle, tee and channel cropper; a universal multiple punching machine, etc. *The Crosby Steam Gage & Valve Company,* 147 Queen Victoria street, London, E. C., exhibited, among other engineering specialties, a relay reducing valve, a British-made recorder and Wallace & Lanza indicator attachments. *Arthur Ross, Hotchkiss & Company, Ltd.,* 1 Glengall Road, Old Kent Road, London, S. E., exhibited the Hotchkiss circulator for marine boilers, a new condenser ferrule, a new watertube boiler, and "Ross' Composition" for removing and preventing boiler scale. *Mayer & Schmidt,* Offenbach-on-Main, Germany, exhibited grinding machinery for railway and locomotive works. Marine circulators were shown by the *Ross Schofield Company,* 117 Leadenhall street, London, E. C. *Clarke, Chapman & Company, Ltd., Victoria Works,* Gateshead-on-Tyne, had a large exhibit of electrical machinery, watertube boilers, winches, windlasses, engines, projectors, etc. *Kynoch, Ltd.,* Lyon Work Works, Witton, Birmingham, exhibited an electric light engine with producer plant, completely furnished on the stand, with a 1-95 brake-horsepower engine, which was running. *W. H. Bailey & Company, Ltd.,* Albion Works, Salford, Manchester, made a very interesting display of pumps, air compressors and steam and water fittings.

Use J-M Permanite Packing and You'll Have No Joints Like This



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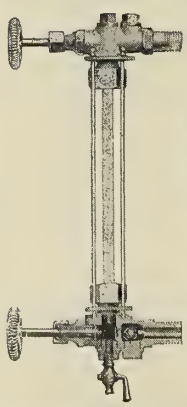

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Write for descriptive circular G-3.

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J. W. BROOKE & COMPANY, LTD., Adrian Works, Lowestoft, report a very flourishing business in marine motors, writing: "We have, unfortunately, got slightly behind with deliveries, and we still have eighty motors on order for completion, aggregating 2,500 horsepower, a large proportion of which are for shipment to our agents abroad. In addition to this we have just dispatched three teak launches to the Egyptian Government, and on the stock are several launches to be shipped to India."

Hutchinson, Rivinus & Co.

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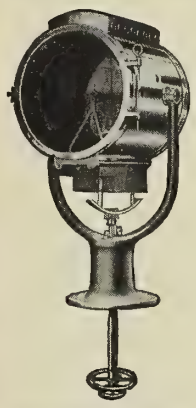

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